Common Commodities and Industries

The Cycle Industry

W. Grew

PITMAN'S COMMON COMMODITIES AND INDUSTRIES

THE

CYCLE INDUSTRY

ITS ORIGIN, HISTORY AND LATEST DEVELOPMENTS

BY

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PREFACE

THE manufacture of bicycles can be truly described as one of the most important industries of the country. The bicycle is also a common commodity, and it is for these two reasons that this book was undertaken. An attempt has been made in the following pages to give a brief outline of the history of the manufacture of bicycles in this and other countries from the introduction of the velocipede to the present day mechanically propelled machine, the motor cycle.

The author has endeavoured to describe some of the more important processes of manufacture and to embody with those descriptions particulars of the numerous other trades on which the cycle manufacturer is dependent.

In conclusion, the writer would like to thank those who have so kindly provided him with illustrations of the machines they make. His thanks are also due to Messrs. Bell & Sons for their kind permission to reproduce illustrations of by-gone models from the late Mr. H. Hewitt Griffin's book, *Cycling*. At the same time he wishes to make the fullest acknowledgments to all who have in any way assisted him with information in any form.

W. F. G.

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THE CYCLE INDUSTRY

CHAPTER I

EARLY HISTORY AND ORIGIN OF THE BICYCLE

In this introductory chapter it is not proposed to deal with the forerunners of the bicycle, such as the hobby horse and some of the more weird wooden machines with four wheels and lever motion, which were known to be in existence before the introduction into this country of the bicycle propelled by cranks attached to the axle of the front wheel, called a velocipede.

We will therefore begin with the velocipede, a type of machine which first attracted the attention of a Mr. Turner, who saw it being ridden and exploited at a Paris school of gymnastics.

At this period in the history of bicycles, about 1868, the city of Coventry had established, by the enterprise of a few Coventry gentlemen, a factory for the production of sewing machines. The firm was known as the Coventry Sewing Machine Company (afterwards The Coventry Machinists Co.), and was founded to find employment for people in the city who had been thrown out of work by the fierce competition of the foreign ribbons and watches which were admitted into the country, either free of duty or on conditions which left very little profit for Coventry ribbon and watch makers. Mr. Turner, who was an agent for the firm, had been asked to look out for something in the mechanical line, suitable for manufacture at the sewing machine factory, and having been much impressed by the novelty and possibilities of the new velocipede, immediately secured a sample of the machine and brought or sent it to Coventry. The directors and managers of the concern there, after a trial of the boneshaker sent over from Paris, decided to begin manufacturing and marketing the machine, and a dozen or so were put in hand at their workshops and proved a success. This bicycle was made with a cast-iron frame, the felloes and spokes of the wheels were of hickory, with steel tyres, and the saddle was a wooden one covered with leather, thinly padded, and supported on a long flat spring of steel; the bearings were plain journals, i.e. in place of steel ball bearings the axles of the wheels were of steel and they turned in chilled cast iron holes in the ends of the forks. The pedals were called "treadles" and were mostly of wood. A machine of this description, ready for the road, was sold in London for about £12, without accessories such as lamp, pocket oil can, shifting spanner, leather toolbag and brake cord, which cost about 25s. more.

The success of this machine made by the Coventry Machinists Company laid the foundation of the trade in Coventry, and it was not very long before quite a considerable business was done by the pioneer firm, and they found it necessary to import into the city mechanics who were more used to the running of heavier machinery than their first employees, engaged in the making of sewing machines.

Many of these men came from a firm of ships engine makers, Penn's, of Greenwich, now merged with other concerns. Among them were such well-known names as George Singer, James Starley, W. Hillman, etc. T. Bayliss and J. Thomas were pioneers in the trade;

the former was a Birmingham gun maker, the latter came from a cutlery shop at Banbury.

Gradually these people started workshops of their own and with local capital and their own savings embarked themselves as manufacturers of bicycles.

Fig. 1

"FACILIS DESCENSUS"

A boneshaker built about 1868

Matters progressed rapidly, and like all new trades it attracted other mechanics and engineers to the city of Coventry. Names such as Haynes and Jeffries, Rudge, Warman, Laxon, Hazlewood, George Townend, Hosier, Hillman, Harrington, etc., are all associated with the early days of bicycle manufacture.

In other towns, Parr, at Leicester, Robinson and

Price, at Liverpool, etc., were gaining a reputation. Gradually the design of the boneshaker was improved, wrought iron frames followed the cast ones, bearings were made adjustable, rims were covered with rubber instead of steel (the early rubber tyres were flat and secured to the felloe by nails), and steel spokes followed the wooden ones.

The great drawback to the boneshaker was its weight, and makers were constantly endeavouring to lighten their productions. Naturally, the saving of weight that first occurred to these pioneers was to make the parts hollow. Many keen practical minds were at work, and one part after another was reduced in weight until there were few parts of the machine that were not made either of hollow steel tube or stamped hollow; even spokes were tried of thin steel tube before the introduction of the suspension or wire wheel. The backbone of the bicycle which was evolved from the boneshaker was of steel tube, at first of flat steel folded and brazed and, lastly, drawn out from a solid steel block without a join, or weldless, as it is termed. The forksides or blades of the fork, the part in which the wheels revolved and which were used to connect the wheels to the backbone, on which the rider sat and propelled the machine, were made hollow in the same manner.

The wheels were at first copies of a light hand-cart wheel, the wood spokes were brought together by tapering the spoke ends and wedging them together at the nave or hub and inserting the other ends in slots in the felloe or wood rim. The whole was surrounded with a flat steel tyre shrunk on by heating the rim, dropping it over the felloe, and when it cooled it shrank and compressed the parts together. That is the principle of the compression wheel, and is used for all wood-wheeled carts and vans to-day. The cycle makers, in their search for lightness, first made similar compression wheels, with hollow steel spokes screwed into iron naves and rims. Then came the suspension wheel which had all the spokes in tension instead of compression. These were first constructed by heading the spokes, threading them through a steel

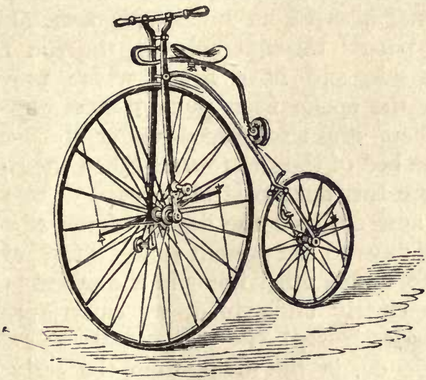

Fig. 2

THE ARIEL BICYCLE OF HAYNES AND JEFFRIES

The wheel spokes were tensioned by levers

felloe or rim and inserting them into screwed nipples which were in their turn screwed into the flanges of the hub. Subsequently the spokes were screwed direct into the hub and tensioned by turning the spoke itself and not the nipples. Mention also must be made of the lever construction of Haynes and Jeffries, the precursors of the Rudge firm. This was an arrangement that tensioned the wheel by pulling a lever attached to the spokes so that they were strained in a direction tangential to their hub and held tight by locking the lever. Following the methods already described, the laced and tangent spoked wheels were introduced. This type of wheel is the modern one that has survived all the others, and reverses the process employed for straight spoked wheels in tension. The flanges of the hub are drilled at right angles, the headed spokes are bent close to the head, and threaded through the holes made in the hub flange. The rim ends of the spokes are screwed and inserted in brass or gunmetal nipples, which are passed through holes in the rim from the top or outside and have heads which prevent the tension on the spoke from pulling them through the rim; washers are also placed under the heads and fitted in the bed of the rim to strengthen the rim at the points where this tension strain occurs.

Having now outlined the design of the wheels from boneshaker days to the present time, a task which was necessary to enable other items in the process of evolution to be clearly understood, we can return to the machine itself.

The tendency, in the main, from the early days to the zenith of glory attained by the high bicycle, or "ordinary" (as it was latterly termed to distinguish it from other types which were introduced) was to increase the size of the front driven wheel and reduce the size of the trailing wheel. In the earliest models of 1868–70 the driven wheel was always the larger, but gradually the diameters of the two wheels became estranged until a driven wheel of 60 ins. was followed by a trailing wheel of 18 ins. There was only one reason why the large wheel stopped growing, and that was because the length of the rider's limb defined the size of wheel he could bestride. It will therefore be almost unnecessary to explain that the further a rider was split up or the longer his legs, the greater advantage

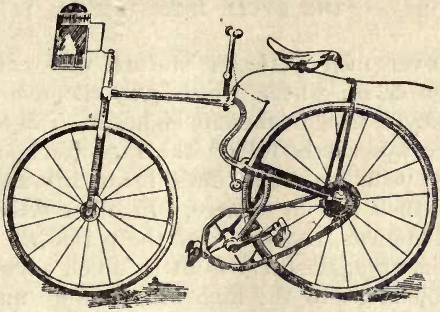

FIG. 3

SHERGOLD'S REAR-DRIVEN SAFETY BICYCLE

One of the earliest examples of this type, said to have been produced about 1876

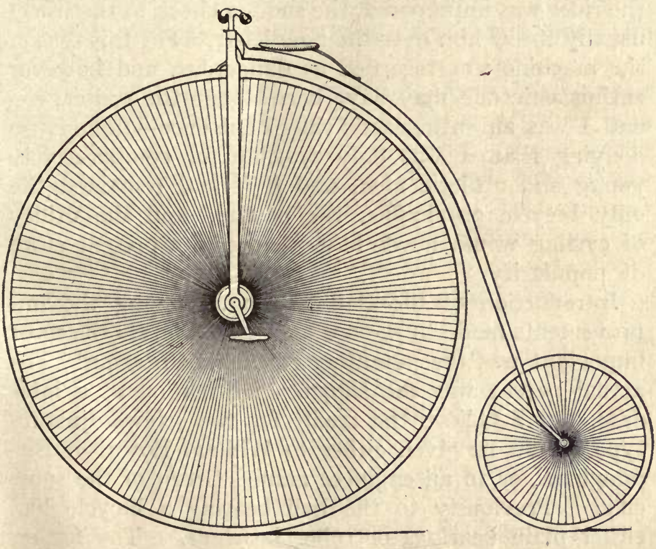

FIG. 4

THE ORDINARY OR HIGH BICYCLE

he had over men of lesser stature who could only straddle a 52 in. wheel, which was the average size of high bicycle used in the late eighties. Tall men were almost always successful on the race track, although lightning pedallers sometimes made up in activity for what they lost in stature. In other words, those of a well-known "bookie" of the period, "I'd back a good big' un against a good little 'un on a hordinary."

The objections to the high bicycle were many, and among its chief drawbacks were that owing to the disparity in wheel diameters and the small weight of the backbone and trailing wheel, also to the rider's position practically over the centre of the wheel, if the large front wheel hit a brick or large stone on the road, and the rider was unprepared, the sudden check to the wheel usually threw him over the handlebar. For this reason the machine was regarded as dangerous, and however enthusiastic one may have been about the ordinary—and I was an enthusiastic rider of it once—there is no denying that it was only possible for comparatively young and athletic men, and if it had remained the only bicycle obtainable, the pastime and the utility of cycling would never have reached its present state of popularity.

Introduction of the Ball Bearing. Among the improvements made to the ordinary high bicycle the most important was the patenting of the ball bearing. The actual patent was the subject of litigation at a later date, but I believe the credit for the screw-adjusting type should be given either to William Bown, of Birmingham, or to an engineer named Green of the same city. Previously to the ball bearing a bicycle had either plain bearings or roller bearings. The former required constant oiling, the latter were not easily adjustable for wear and entailed a heavier construction than ball bearings. Bown then, or Green, brought out a bearing which consisted of a grooved cone and two cups, the grooves in all three being slightly wider in radius than the diameter of the ball. When wear took place the cups or one cup were screwed inwards and relocked. These were separate proprietary articles and were attached to the fork of a bicycle by cotters and nuts. The rear wheel was provided with a slightly different type of ball bearing, the adjustment being effected by screwing the cones or one cone inwards instead of the cup or cups. Subsequently ball bearings were applied to the steering and the pedals, but an indication of their importance may be gained by the fact that for a long time the manufacturers catalogued their machines with plain bearing pedals and charged 30s. extra for ball pedals.

We have now arrived at the stage when a high bicycle was regarded as dangerous, and, if the front wheel were too small, it detracted from the rider's speed owing to the shorter distance covered by each turn of the wheel. What was the next move? The engineer's mind turned towards a method of gearing by cogs or chains, by which one turn of the crank axle would cause the driven wheel to turn more than once. That is where we get our method of describing the ratio of gearing between the crank and the wheel of a modern safety bicycle. The previous machines had wheels, say, from 50 ins. to 60 ins. in diameter or height from the ground. Now supposing you took a 25-in. and a 30-in. wheel and by means of gearing made them turn twice to each turn of the pedals and cranks, they would be equal to 50-in. and 60-in. wheels—without gearing—that is why we still speak of a bicycle with 28-in. wheel being geared up to, say, 56 ins. when it travels as far for one turn of the cranks as a wheel of 56 ins. does in one revolution.

Various devices were tried for rendering the high bicycle safer to ride, but none was commercially successful except, perhaps, the Facile.

The Facile was introduced primarily to enable the rider to sit further back along the backbone, and, instead of the pedals being attached direct to the cranks, the ends of the cranks were connected to levers pivoted on extensions of the forksides and having a bearing for attachment of the connecting rod about one-third of the distance along the lever from the pedal end. The rider, therefore, pedalled by pushing the levers down alternately and releasing the pressure at the end of the strokes. The Facile was followed at a later date by the Geared Facile, which was the same design as the Facile and had the same lever motion for pedalling, but included a sun and planet gear on the hub. Briefly, this consisted of a large toothed wheel on the axle and a crank extending beyond the edge of the wheel. Working in a bearing on the crank end was a small planet pinion, or toothed wheel, which meshed with the larger toothed wheel. Pressure on the pedal caused the planet wheel to travel around the larger sun wheel and the road wheel was geared up to the extent of the added diameter of the planet wheel. Thus, if the planet wheel were one-fourth the size of the sun wheel, it geared up the road wheel of 45 ins. to 56¼ ins. or thereabouts.

Then, with a bound came the geared up front driver; the first was the Kangaroo, produced by Hillman, Herbert and Cooper. This machine had wheels of about 36 and 24 ins., the front (of 36 ins.) being driven. To gear up the wheel the fork blades were extended beyond the centre of the wheel, towards the ground, and bent slightly backward. At each end was a bearing for a separate crank, and attached to the crank shaft, which ran on a ball bearing and was very short, was a chain wheel. This wheel was slightly larger than a similar wheel on the hub and the two wheels were connected by a chain. The arrangement was duplicated the other side of the main driven wheel and, as already

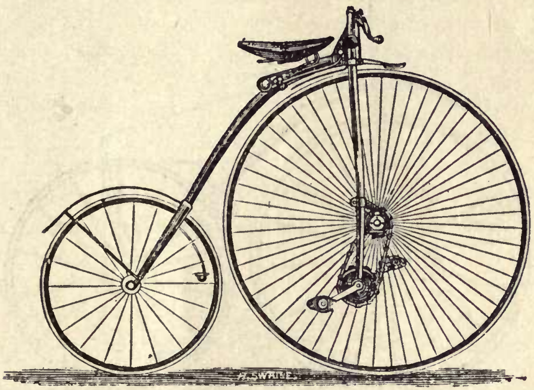

FIG. 5

THE KANGAROO INTRODUCED BY HILLMAN, HERBERT AND COOPER

explained, owing to the gearing up the wheel was turned about $1\frac{1}{2}$ times for one complete turn of the crank axles. Many hundreds were sold, but owing to the short crank bearings and the difficulty in keeping the chains equally adjusted, the vogue was comparatively short lived.

The Kangaroo was followed by the geared ordinary and the Bantam, Boothroyd's patents. The first was a dwarf ordinary with a gearing in the front hub, which had the same effect as the chains and sprockets of the

Kangaroo, but employed spur wheels with teeth all enclosed in a casing formed by the hub shell. The "Bantam" had smaller wheels and a similar gearing.

Various attempts had been made, about 1876–79, to design an absolutely safe bicycle. H. J. Lawson produced a machine, in 1876, which was practically

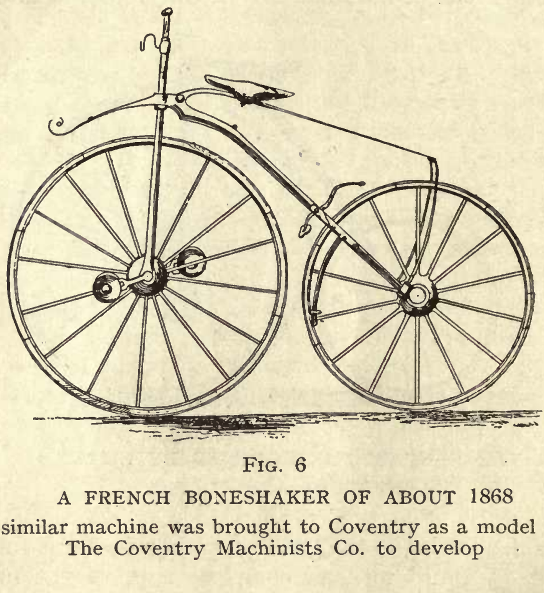

Fig. 6

A FRENCH BONESHAKER OF ABOUT 1868

A similar machine was brought to Coventry as a model for The Coventry Machinists Co. to develop

equivalent to enlarging the rear wheel of a high bicycle, leaving the front wheel the same size and driving the rear wheel by a lever motion. The lever motion, as distinct from the rotary crank, was the first form of driving medium used on wood four-wheelers prior to the velocipede or boneshaker. Briefly, when brought out on Lawson's rear driven bicycle, it comprised a crank on each side of the hub and keyed to the axle, a continuation of the frame carrying a bearing for the foot lever. At a point along the foot lever, varying

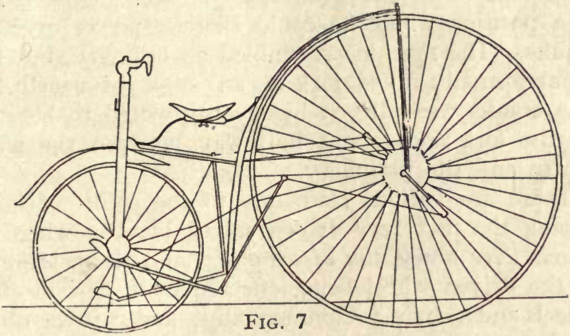

FIG. 7

A VERY EARLY LEVER-DRIVEN SAFETY BICYCLE

This model preceded the chain-driven type by about two years

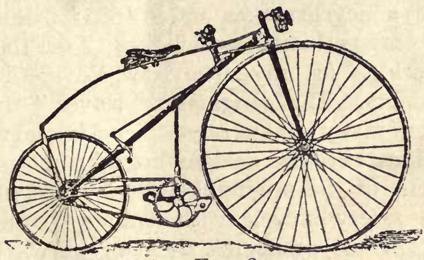

FIG. 8

LAWSON'S CHAIN-DRIVEN SAFETY BICYCLE WHICH FIRST SAW THE LIGHT ABOUT 1878–9

with the type of machine, was a bearing for a connecting rod which connected the crank on the hub axle to the foot lever, in a similar way to the Facile already described.

The Singer Xtraordinary Challenge was another model that was introduced to put the rider further back and down the backbone and yet to leave him in a position where he could exercise power over the cranks. The machine resembled an ordinary, but had an abnormally raked fork at an angle of nearly 30°. The cranks were driven by levers pivoted to bearings on the fork-sides about half way between the wheel centre and the periphery.

There are various claimants to the credit of introducing the first rear driven safety bicycle, where *the wheels were practically of equal size* and the gearing up of the driven wheel being effected by a pair of chain wheels and a chain. Commercially—and it is the object of this book to show the growth of the industry from a business view point—the honour is due to the late J. K. Starley, nephew of the original James Starley. Mr. Starley was in partnership with a Mr. Sutton in Coventry as a bicycle maker, and in 1885–86 designed the "Rover" safety bicycle which has "set the fashion to the world," as, say, The New Rover Cycle Co.'s advertisements. The original "Rover" was the forerunner of many famous safety bicycles, and numerous and ingenious were the designs brought out to obviate infringement of the original registered design and yet produce a safety bicycle with similar characteristics.

Starley's frame connected the two wheels by forks, but there was no tube connecting the saddle and the bottom bracket as was afterwards done by Thos. Humber, at Beeston, Notts. An inspection of the illustration of the original Rover frame is the only way to understand what is meant by the above description. The Rover safety bicycle sounded the death knell of the "ordinary" and gave an immense impetus to the industry.

Humbers produced an open diamond frame with all the tubes straight, which was, of course, the correct method from an engineer's view point. The Raleigh Co., at Nottingham (then Woodhead, Angois and Ellis) made a similar machine. Makers sprang up all over the Midlands and in the London district. A famous road racing cyclist, Dan Albone of Biggleswade, designed the cross frame safety bicycle, and this was largely copied by others too numerous to mention.

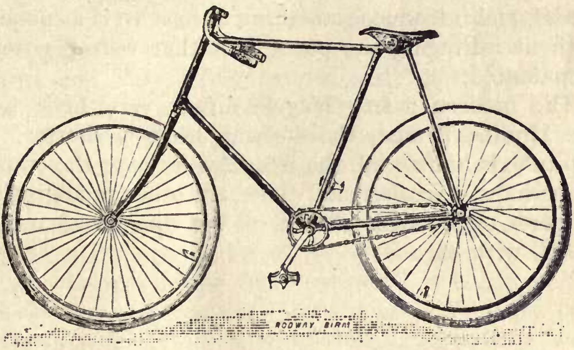

FIG. 9

THE RALEIGH CYCLE CO.'S DIAMOND-FRAMED BICYCLE

Later the designers of the famous Humber firm at Beeston, near Nottingham, introduced the Beeston Humber frame. This was the forerunner of the present day safety bicycle and has been little altered to this day. Originally, the Beeston Humber had equal wheels of 28 ins., a straight tube diamond frame with a fairly long steering head and the top tube sloped slightly upwards. Naturally, the model was copied by almost every manufacturer.

Other models, of course, had a big run. A firm in London, G. L. Morris & Co., designed a popular machine about 1886–87 ; this was named the Referee and may be said to be a pioneer pattern much favoured by London club riders. The makers of the Premier, at Coventry, brought out the Catford Premier about the same time. None, however, survived the original Beeston Humber design and although Coventry and Birmingham makers adhered for long to their pet patterns they had to admit, one by one, the soundness of the original Humber model, and introduce something as near to it as possible without infringing the parts of it that were registered or patented.

The modern safety bicycle differs very little from the Humber frame, the steering head is shorter, the top tube is horizontal, the tread (width over the cranks) is, perhaps, narrower and there are other modifications in parts, dealt with elsewhere, but the broad outline is still with us.

CHAPTER II

THE TRICYCLE ERA

THE tricycle was undoubtedly introduced to combat the danger of riding the high bicycle. Riders of the early models of these machines will, however, confirm my opinion that they were far from safe, and if one did get a spill from one it was almost certain to result in a mix up with the wheel spokes and other mechanism, because one was seldom thrown clear of the machine as in the case of a fall from a bicycle.

The tricycle did, however, provide a means of cycling for those who could not manage a high bicycle and, of course, ladies were enabled to indulge in the pastime for the first time since they had ridden pillion fashion behind their squires on the old hobby horses.

The type of tricycle that first made a name in the industry was the machine invented in 1877 by the late Mr. James Starley, uncle of the Mr. J. K. Starley who subsequently made the name of Rover a household word throughout the kingdom and far beyond.

This machine was named the Coventry Lever Tricycle, and was driven by pedals and levers. It had a single driven wheel and two steering wheels, the latter being moved to and fro by a side handle like that of a spade, rods and a rack and pinion. The latter form of mechanism consists of teeth on a small wheel engaging with similar teeth on a flat strip ; the small wheel or pinion is attached to the actuating rod and by turning it the rack is moved to and fro. The same mechanism is used to-day for the steering of very low-priced small motor-cars, and the movement of the wheels is thereby geared down. It was used on early tricycles for the same reason, viz., that a relatively large movement of the spade handle only diverted the steering wheel of the tricycle a small amount, which gave the rider more control over the steering and prevented the wheel from

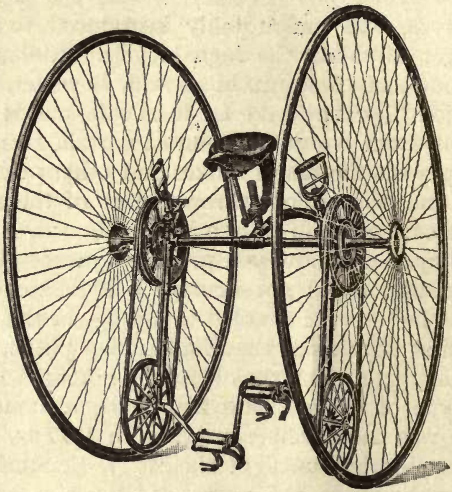

FIG. 10

THE OTTO BICYCLE

A two-wheeled machine which required to be balanced in the fore and aft directions

being twisted out of his hand. Among the well-known tricycles that followed the original of James Starley were the Challenge (Singer & Co.), the Salvo (Starley & Sutton), etc. James Starley was the first to use a balance geared axle on a tricycle; this is a piece of mechanism that is embodied in the axle and divides the shaft into two parts. It will be readily seen that, when a tricycle is turned, the outer wheel that describes

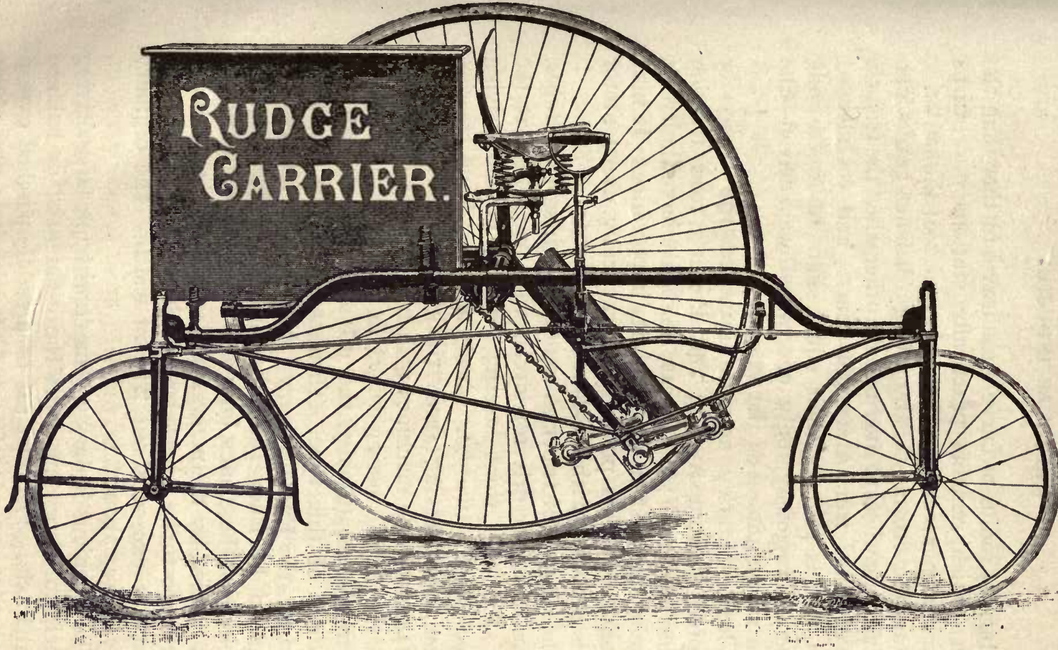

FIG. 11

The Rudge Rotary tricycle was introduced to enable the machine to enter narrow doorways, the storage difficulty in the case of ordinary tricycles being always a problem the biggest radius or curve must travel further than the inner, which remains practically stationary or turns very slowly, according to the sharpness of the curve.

Starley overcame this by fitting a balance gear which enabled one wheel to over-run the other when the tricycle was deflected from a straight course, and yet allowed both wheels to take their equal share of the driving power. Previously, only one wheel was driven—the other running loose on the axle.

Whether Starley actually invented the device or adapted it from Aveling and Porter's road traction engine is obscure ; in any case he should have the credit of being the first to recognize its importance. It may be added at this point that practically every motor car is provided with a balance geared axle.

The designs of tricycles went through several stages. There were rear driven tricycles with one wheel at the rear and two front steering wheels, double driving tricycles with two rear wheels and one front steering wheel, both having three tracks. The advocates of two tracks made machines with two rear driving wheels and the front steering wheel in a line with one side driving wheel (usually the off side)—the Royal Mail was one of this type. Then came a most ingenious machine, the Rudge Rotary. Haynes and Jeffries, who preceded D. Rudge and the Rudge Co., had made a machine on these lines, but when the storage of a tricycle was tackled by the makers it was found that to enable a tricycle to be wheeled through narrow doorways it must not exceed about 2 ft. in width. The ordinary tricycle was about 3 ft. wide.

The ingenious Rotary was made with one large driving wheel, so dispensing with the differential or balance geared axle. The rider sat on a saddle perched over a frame that extended fore and aft with its centre about

18 ins. away from the big driving wheel. The side tube of the fore and aft frame had a small steering wheel at each end, carried in forks, and the two were interconnected by a rack and pinion, so that one steering handle of the spade type turned both wheels simultaneously to the correct degree to allow one to follow the path of the other when turning.

This machine had a big vogue and was fast and fairly light. It certainly made the reputation of the Rudge Co. in those days.

Another type of tricycle that was much favoured was the Humber front steerer. This was made with a backbone and trailing wheel like a bicycle, the axle was balance geared and ran in bearings connected to a frame that sprang upward to form the steering head and downward and rearward to carry the crank axle and its bearings. It was steered by moving the two driving wheels by a handlebar just like a bicycle. Its one disadvantage was that owing to the construction the machine had approximately to fit the rider's length of reach.

Following this type of tricycle it was natural that the advent of the rear driving, front steering safety bicycle should have turned designers' thoughts to make a tricycle like a safety, only with two rear wheels in place of one. Humbers were one of the first to make a tricycle with a front steering wheel in a fork like a safety, and they named it "The Cripper" after the name of a professional rider, Mr. Robert Cripps, who won many races on it on road and track. Bob Cripps, as he was known to track frequenters, is alive to-day and runs a motor garage business at Nottingham.

From the days of the Humber Cripper tricycle this type of machine has advanced along very similar lines to the safety bicycle. Gradually the size of steering wheels increased, and driving wheels, once about 44 ins., decreased till they became all one size, 28 ins., then 26 ins., where they remain to-day. The side elevation of a modern tricycle is exactly the same as a safety bicycle, and the weight of the road racing tricycle is sometimes no more than an average roadster safety.

There are cyclists, like Mr. F. T. Bidlake, who prefer a tricycle to a safety, and to such men a long ride on a tricycle is no more fatiguing than a safety bicycle ride of the same distance.

Very few large manufacturers, however, cater for the tricycle trade as the demand is so limited, and tricyclists mostly obtain their machines from local assemblers, who are much aided in their work by the beautiful tricycle balance geared axles made by the Abingdon firm of Tyseley, near Birmingham. This concern was one of the pioneers in the industry and originally were small arms makers in the gun making quarter of Birmingham.

Tandem tricycles and sociable tricycles are machines of the past. The latter were ponderous affairs weighing over 1 cwt. and mostly made by taking a front steering tricycle or a Rotary and coupling another wheel, crank axle and chain to the existing frame and extending it outwards to accommodate the seat or saddle of the companion rider.

Tandems were rather a different affair. The Olympia tandem of Marriott and Cooper and the Beeston Humber tandem were fast reliable machines. The former had a single rear driving wheel and two steering wheels actuated like the steering wheels of a motor car, i.e. each wheel was separately pivoted. The saddle for the front rider was carried on an extension of the frame and the handle-bar was bent to pass behind the rider's back. Chains were used to convey the transmission and the later models had equal sized wheels and pneumatic tyres. The Beeston Humber tandem tricycle was exactly the same as the solo machine already described; it had a saddle for the front rider on the swivelling portion of the frame that carried the combined

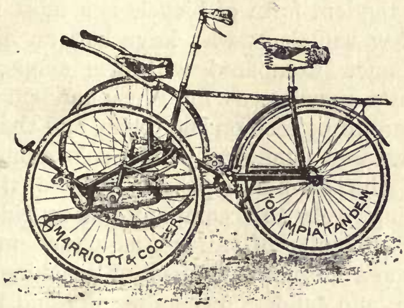

FIG. 12

A TANDEM TRICYCLE CALLED "THE OLYMPIA"

driving and steering wheels. Owing to the way the weight of the two riders was distributed, one in front of and the other behind the axle, the machine was well balanced and much faster than any other machine of the tricycle tandem type—until the introduction of the tandems made on the lines of the modern tandem safety, only with a pair of double driving rear wheels in place of a single wheel.

CHAPTER III

TANDEM BICYCLES

THAT the tandem form of bicycle is a most fascinating machine few will deny who have had an opportunity of riding one. Compared with the single, however, they are not popular, as for every tandem thousands of singles are to be seen on the roads, and that is caused by the increased handiness of the solo mount and the fact that the double type necessitates the partner always being ready to accompany one on rides. There is also the difficulty of storage, as a tandem bicycle is not the most convenient form of machine to stable in a house, and tandem owners usually find it essential to provide accommodation for the steed in an outhouse.

The earliest practical forms of tandem bicycle began to appear on the roads about 1893, or contemporary with the pneumatic tyre. They were, of course, introduced to permit the use of a bicycle by a lady and gentleman, and all early models were designed for the lady to occupy the front saddle. Among the firms who were pioneers of this type of machine one remembers the Humber, the Singer, the Rudge, the Raleigh, the Whitworth and the Chater Lea.

By placing the lady in front it was thought in those days that she must occupy the place of honour, and the fact that she was likely to receive the first brunt of a collision, not to speak of cold winds, was forgotten. Naturally, the mere male was entrusted with the steering and balancing, and to enable these functions to be controlled from the rear handle-bar the two sets of handles had to be connected by a rod on the off side. This arrangement meant that the front rider had handles to hold but was not expected to do any steering or balancing, or she interfered with her partner's control of the machine, and by ignoring the instructions might cause a spill at a critical moment.

The early frame designs were rather crude, as might be expected, and consisted of a strengthened dropped front frame attached to a rear quadrilateral terminating in the usual rear fork. The rear rider's pedal crank axle was connected to the front crank axle by a chain, so that the thrust of each rider's pedals were communicated to the rear road driven wheel.

The frame described above was weakness itself, and much binding of chains and bearings caused the machine to run rather hard.

It is difficult to say who first introduced the lady back tandem, as the modern type is described, but tandems for two male riders had been in use for a long time before the dropped part of the frame was placed at the rear. I believe the late P. L. Renouf made one of the first lady back tandems, at Humber's Coventry works, but doubtless others may claim the title of first.

The design of G. P. Mills, when at the Raleigh Co., Nottingham, was regarded as the most scientific type of tandem frame for years, in fact it remains unbeaten to-day. This frame is triangulated from front to rear and can be ridden by two women, wearing skirts, by a man and woman, or two men.

The tandem has got a bad name as a roadster because so many imagine that it requires harder pedalling uphill than a single. I do not agree absolutely with this opinion, and I think it has arisen chiefly because tandem pairs do not practise together sufficiently often to acquire the unity of action that is required to make hill climbing as easy on a double as a single. Also, tandems are often geared too high. On level ground and down hill the tandem scores every time, principally because the surface area offered to the air resistance is but little more than that of a single machine and rider plus the increased propulsion effort of the second rider. Weight also counts down hill. Luggage carrying capacity is said to be reduced to that of a single because there is only the space over the one rear and one front wheel in which to place carriers for two people. This may be an objection, but in my opinion a tandem is an ideal touring bicycle for husband and wife, because the weaker efforts of the lady rider can be compensated to some extent by the more energetic and powerful pedalling of the partner. Strickly speaking, both efforts should be equal, but providing the double power is applied to the cranks evenly and at the correct crank position, there is no retarding effect if one rider exerts more power than the other.

In the case of the modern lady back tandem, the rear handle-bar is a fixture and only the front one is used for steering and balancing in the usual manner.

The increased cost of motoring has had something to do with the recrudescence of the tandem bicycle, as there is evidence of more of these machines being used this year than for some time past.

CHAPTER IV

MATERIALS

THERE is little doubt that the pioneers of the industry had a hard up-hill struggle with materials in the early days of the bicycle. The parts makers all had to be educated to their requirements. We have read that the early velocipedes had cast iron frames, wood wheels, long bow springs for the saddle and steel tyres. No great difficulty there, because the carriage builders of that time were conversant with the parts required. When tubular backbones, wire spokes, ball bearings, special stampings and castings, india-rubber tyres, steel tyre rims, handles, saddles and other parts were required, makers of these had to be found, and not only manufacturers of the goods but those capable of making them to a specification. Coventry, the home of the cycle trade at that period, was not a manufacturing town in the sense that Birmingham was and is the centre of the steel toy manufacturing industry.

It was, therefore, natural that in their search for suitable unfinished and partly finished materials the Coventry engineers and mechanics turned to Birmingham and the adjacent Black Country towns to provide them with much of the raw and partly finished material. Sheffield supplied bar steel for bearings, wire for spokes, handles, made of horn on steel shanks, etc. Walsall provided saddles. Springs came from Sheffield and Redditch, and so on.

Without the beautifully drawn steel tube for backbones and later for frames, which was produced by firms like the Weldless Steel Tube Co. and other firms now merged in Tubes, Ltd., it would have been impossible to produce a bicycle at the weight required. Other Birmingham firms made balls for the bearings; at one time these were cast or moulded like old-time bullets, placed in grinding machines and rubbed round (or as near to a sphere as possible, they were many thousandths of an inch out of round) with emery powder and oil. Each ball was worth a shilling at one time and the writer has paid that sum for them.

Then came ball making machinery, each machine specially constructed by the ball maker such machinery could not be purchased. One maker of balls, to produce them at a price, went into the country and used water power and more or less secrecy to keep his trade and knowledge to himself. Afterwards machinery was designed and first made by Mr. W. Hillman and erected at Coventry for cutting balls from steel wire. Foreign makers also flooded our markets with cheap balls. Imagine the early struggles of men like the late James Starley, George Singer, W. Hillman, Thos. Humber, and many others, every time they altered a part they had to make, with their own hands and tools, patterns in iron, brass, or gun-metal, take or send them to specialists in stampings, or to a coachsmith, and have the first few parts made, forged bit by bit by hand. These men had no draughtsmen, no pattern makers, everything was the product of their own heads. Gradually, when the pioneer work began to show results, manufacturers in a larger way of business were attracted by the requirements of the bicycle trade, but the above-named pioneers did most of the spade work.

The assistance of Birmingham was not exactly without its risk to Coventry, because in the production of parts and materials this larger city began, when slack times came, to look round for outlets for a production that

Coventry could not always assimilate. Birmingham produced parts of bicycles but few complete machines. Large firms, notably Perry & Co., Ltd., the pen makers, the Birmingham Small Arms Co., and others, began to supply sets of fittings for small makers, who were thus enabled to make bicycles with the engineering part

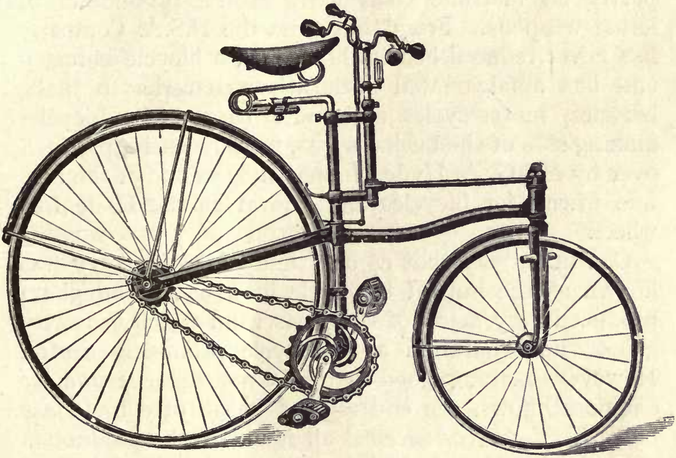

FIG. 13

THE B.S.A. SAFETY BICYCLE

The forerunner of a famous firm's products

that required first-class machinery largely eliminated. The Eadie Manufacturing Co. was established at Redditch by Albert Eadie, Perry & Co.'s sales manager, and Robert W. Smith, a Coventry engineer from Rudge's big factory. The B.S.A. Co.'s machinery at Small Heath, Birmingham, was not fully employed on rifle contracts, and the directors looked about for other suitable mechanical work to keep their staff employed. Bicycles were largely demanded. The firm's engineer was at that time O. P. Clements, a Swede, who had come to Birmingham to organize the B.S.A. gun and rifle production. He was consulted about bicycles, the idea at first being to make complete machines. After he had thought over the question he said he knew nothing about bicycles but he could make the parts of bicycles, partly on machine tools used in the production of lethal weapons. From that time the B.S.A. Company has never relinquished its hold on the bicycle industry and has amalgamated with other concerns to make bicycles, motor-cycles and motor-cars. The bicycle-making side of the business was, until recently, presided over by Mr. G. A. Hyde, the patentee of one of the best free wheels for bicycles and known as the Hyde free wheel.

One might say that at one time while Coventry was known as the hub of the cycle industry, Birmingham produced very many of the parts from which Coventry gained its reputation as a bicycle producing centre. However, making good parts is not, as every cycle engineer knows, the end all and be all of a first-class bicycle. Coventry excelled all round in the production of perfectly made frames, hard, wear-resisting bearings, and in the finish of the completed article. Birmingham was the mass producing centre in the early days, and gradually the industry spread to Wolverhampton. It was established by Thos. Humber at Nottingham, by Albert Eadie at Redditch, and by others at London, Leicester, and many other places. Coventry is still largely dependent on Birmingham and district for most of the steel tubing from which bicycles are made, the steel bars for bearings come mostly from Sheffield, the springs for brakes and saddles from Redditch; saddles are made in Coventry but larger quantities are produced in Birmingham and Walsall. Tyres are almost wholly produced in Birmingham, some in Edinburgh, Leicester, and, again, some in Silvertown, Essex. The castings and stampings are produced in Coventry, Birmingham, Walsall, Dronfield, Oakengates, etc. Rims are made in Birmingham and Coventry.

The industry may now be said to have spread all over the Midlands, Yorkshire, and parts of London. In fact there are very few places now where something or other is not made which is used in the manufacture of bicycles. Wolverhampton, Birmingham, Bristol, London, etc., supply the enamels and paints used for the finishing of the frames and wheels. Yorkshire, Coventry, Birmingham, America, and before the war, Germany, supplied machine tools. Nickel plating materials are supplied from Birmingham but some of the material comes from overseas. Sweden sends the steel blocks from which the steel tubing is made. Tin plates for chain cases come from South Wales, celluloid for handles from Germany, leather for saddles from the Argentine, balls for bearings from Sweden, rubber for tyres and pedals from South America, Ceylon, Java, etc. So one might go on enumerating the different centres of industry that supply the cycle trade ; but it does not require much imagination to compare the early struggles of the pioneer cycle mechanics with those of the present day, who have largely to fit together what is made for them by other producers.

CHAPTER V

FROM THE STORES TO THE RAILWAY DRAY

In writing a chapter on the production of bicycles under the above heading it is possible to describe each process in detail until one would have quite a large book on that subject alone. It will be readily understood that in a book of this size such microscopic attention is impossible. It is, therefore, my intention to take the reader a personally conducted tour round a large cycle factory, commencing at the stores and finishing at the loading bay of the packing department, and refer briefly to each process in passing. We will imagine, therefore, that the entree has been secured to look over a cycle factory where everything except saddles, handles, tyres, and toolbags, is produced on the premises and assembled to make a complete bicycle. Arrived at the rough stores we find bins on the floor and racks lining the walls right up to the roof. In the racks and bins are steel tubing in multiple lengths of several feet, ready for cutting up into frame tubes, bars of steel of various sizes for making into cups, cones, and spindles for hubs, castings and stampings for frame lugs, spokes in bundles, steel and wood rims of various sizes, and of course, the usual stock of steel and other stores required by the factory millwrights for engineering purposes other than the actual construction of the bicycles.

Each stores has its own storekeeper, a clerk who specializes in organizing his department so that there is not a superfluity of one article and a scarcity of another. The various articles as they are delivered are counted, weighed, or otherwise reckoned, and a

FIG. 14

THE FRAME-BUILDING SHOP OF RUDGE-WHITWORTH, LTD., COVENTRY

The hoods in the background are arranged over the brazing hearths to carry off the fumes record on cards of the number or weight is placed over each bin or rack. As the articles are requisitioned by the factory management, the numbers or weight extracted from bins or racks are noted on the cards and the supply made up from outside, the aim of a good storekeeper being to maintain a certain high-water mark, below which the stock is not permitted to fall.

Very little of the material issued from a rough stores ever comes back again, but the state of things in the finished stores is different. Here, again, are bins, fixtures (a series of shelves in wood or iron with vertical divisions like large pigeon holes of a desk), and racks, but they all hold finished or partly finished parts. Thousands of axles, cups, cones, balls, nipples, nuts, screws, etc., will be seen all neatly arranged and docketed, the racks hold finished frames, forks, saddles, mudguards, brakework, etc.

The procedure here with regard to issuing the parts is that a requisition comes from the office management, sales or other department, to put through, we will say, 100 machines of a certain model (the requisitions in some factories are much larger, but we will take the above figure as an example). The storekeeper in the rough stores issues to the machine shop and frame builders 100 sets of frame lugs, 100 sets of tubes cut to length and mitred, enough tube to make up 100 seat pillars, fork-sides, and crowns for 100 forks, 200 rims, the necessary spokes, and so on. These are made up into complete frames, wheels, forks, etc., and go when completed to the finished stores; here they are viewed, and re-issued to the finishing department with the necessary tyres, saddles, handles, brakework, and so on.

Each time the parts enter the stores from the factory the work done is entered and the operatives are given credit for the work done, and the cards or books pass along to the wages office, where those who are on piecework rates are credited with the various amounts, and paid weekly, or the amounts are allowed to accumulate for a period settled between the shop stewards and the management, and the workpeople draw a weekly wage on time clocked, balancing the account at intervals.

In very large factories there may be a separate stores for tyres, another for brakework, frames and forks, and another for wheels, each floor or department having its own stores. Whether this arrangement or the one outlined is followed, the procedure is practically the same as regards the checking and recording of the work as it passes through the various processes.

Frame Building. We now enter the frame building shop, where the lugs and tubes are built up to make the frame. The lugs, in the form of castings or stampings, have been machined in the machine shop. This consists of placing the lug on a jig (a tool that holds the lug at the correct angle for turning, drilling or boring) which is bolted to the lathe or drilling machine which forms it. Iron castings are hollow and have little superfluous metal to be removed, stampings are solid and the steel to be machined away is considerable. Modern methods, however, allow either to be dealt with with practically equal rapidity, and when completely machined each lug weighs only a few ounces. Some firms, notably the Raleigh and Rudge-Whitworth, use pressed steel lugs, a process which presses the lug from sheet steel, which is folded, so to speak, between dies in a very powerful screw, or other type press. The frame builder is provided with a sort of master frame, called a jig, on which he assembles the lugs and tubes roughly, and when they are positioned by stops on the jig he turns screws which lock the parts while he drills holes at each joint for conical metal pegs which keep the tubes in place while the joints are brazed. The frame builder is responsible for the correct alignment of the frame. When the joints are pegged he passes on the frame, or it is taken for him, to the brazing shop.

Brazing. Brazing is done in different ways in different factories, some adhere to hearth brazing, others use the more modern liquid brazing. Brazing is really soldering with hard brass, as distinct from soft solder. In hearth brazing an open fire of "breeze" (small coke) is kept at a high temperature by allowing a pressure coal gas flame to impinge on the glowing coke. The joint of the frame is pushed into the fire, but before the frame builder parted with it he had coated the two metals to be united with a flux to facilitate the flow of the brass. The brazer has in his hand a "stick" of brass or a spoon filled with brass dust called "spelter." When the joint has reached the correct temperature he feeds it with the "stick" or "spelter," and the flux carries the molten brass into the joint. Parts on which the brass should not adhere are specially coated to prevent the molten brass from sticking to the steel or iron.

The other process, called liquid brazing, consists of placing the joint of the frame or other part into molten brass spelter, heated in a special kind of gas oven. The part is withdrawn when the brass has run into and between the two surfaces to be brazed.

After brazing, the frames and forks go into vats and are pickled. This is a bath of corrosive liquid that attacks the rough spelter and softens it previous to the filing up of the joint, or, if the firm has a sand blasting shop, the rough spelter is blown off by a strong current of air, in which sand or shot is carried, and forced on to the joint from a flexible pipe held in the operator's hand, the frame, fork, etc., being supported on a bench. The sand blasters wear masks and cloaks which make them appear like the pictures of torturers in illustrations of the old Spanish Inquisition.

From the filing up or sand blasting shops the frames go to the iron polishers. These men or women (for female labour is employed for polishing) hold the frames on grinding wheels or in some cases endless belts coated with emery, and they grind or polish the whole frame till it is bright and very smooth.

The frames and forks then go to the enamellers, a part of the factory we shall visit presently, when the other parts are ready for the painting process.

The Machine Shop is the department where all the parts that require turning, boring, milling, or profiling, are machined, as the various metal removing processes are termed. Here we may see turret lathes, forming hubs from bar steel, milling machines, forming the teeth on sprocket wheels for the reception of the driving chain, milling or profiling cranks, turning and boring frame lugs and fork crowns, profiling the internal parts of free wheels, and a hundred other small parts that go to make up brakework, pedals, etc. Small screws, nuts, steps, bolts, etc., are usually bought from specialists who can make these parts from steel bars in automatic lathes at very much lower prices than can a cycle manufacturer, who would have a comparatively few of each to make before he had to change the tools in the machine. Hubs are made from stampings and castings as well as from bar steel, opinion being divided as to the economy of the three processes.

The wheel building is often done by women and girls. The steel rims are drilled or punched in special machines which space out the holes evenly, for 32, 36, 40, or 44 spokes, according to whether they are to be used in front wheels, back wheels, racing or roadster machines. The spokes of steel wire are supplied headed, bent, and screwed. Where the screwing is rolled on instead of being cut with dies, each spoke is apparently only touched against the rolls and the thread appears. The rolling leaves the skin on the metal and enables a lighter wire to be used, because it does not cut through the skin and weaken it.

The nipples are of brass or gun-metal and the washers of steel. The wheel builder laces the spokes through the holes in the hub flange, then through the holes in the rim and slips a washer and nipple on the end of each. When the wheel is loosely assembled it has to be trued. This is a process that requires skill to obtain the same degree of tension on each spoke and is effected by screwing the nipples down the spoke with a special nipple key turned by hand or power on the end of a flexible shaft. The final truing process is done entirely by hand.

Brakework and mudguards are usually made up in a separate shop or on a separate bench. The mudguards are rolled by specialists from flat strips of thin steel and are delivered to the makers bright, ready for attaching the stays and bridges. The latter are the strips of metal laid across the mudguard and riveted to it, or, in some cases, electrically welded or brazed. The eyes are formed on the stays or they may be separate parts brazed or welded to the stays.

The brakes vary a good deal on different machines, but on high-class bicycles they are usually operated by Bowden cables and wires which are concealed in the handle-bar and are operated by inverted levers underneath the hand grips. The Bowden mechanism obviates all bell cranks, rods, and other levers because it conveys a direct pull to the brake while passing around angles which are not too acute to prevent free sliding of the wire inside the cable.

Another popular type of brake is the roller lever brake. This is usually made up by the cycle maker to suit his own models and consists of a lever placed each side of the handle-bar which rolls or turns in a bearing. At each end of the lever there is a crank which pushes down a rod in communication with the front or rear brake shoes. The handle-bar brakework is usually assembled on the bar ready to slip into the machine in the finishing shops.

Handle-bars are largely bent by specialists, but some firms make their own. The process is usually to bend the touring patterns cold by inserting a spring mandrel in the straight tube, to prevent the metal kinking or denting, and withdrawing the mandrel by unwinding it. The curly types of handle-bar affected by racing cyclists often have to be filled with sand or rezin prior to heating and bending, the "loading" material, as it is called, being afterwards melted and poured out.

The stem of the bar may be inserted in a "T" lug threaded on the bar, or it may be made entirely from steel tube. In the latter case some skill is required to wrap or "lap" the top of the split stem around the bar to make a neat joint. Seat pillars are nearly always made by the "lap" joint method; a good bicycle may be often known by a careful examination of these joints, because a maker with a reputation employs men who can make these joints practically invisible, whilst the shoddy ones have rough edges and imperfectly made joints.

As the polishing, plating, and enamelling have to take place before the machine is assembled, we will visit those shops before going to the finishing shop, the term applied to the bay or floor, where the bicycle receives its final touches.

Polishing is a process that consists of holding the parts, large and small, on wheels of various diameters and widths that have on their edges or peripheries leather coated with emery dust which adheres to glue with which the wheels are coated. The final polishing (plate polishing) is done with wheels made of discs of calico, which assume a certain rigidity suitable to the work when they are revolving at high speed. The disc or wheel of calico discs is called a "mop" and the process is termed "mopping," to distinguish it from the coarser polishing. The calico is impregnated with grease and tripoli or rouge powder and also powdered lime or whiting.

The polishing shops resound with the whir of the polishing lathes and the air is largely impregnated with dust of steel, emery, glue, and leather. The operators are supposed to wear respirators, goggles, etc., to protect their lungs and eyes, but more often discard them when the foreman's eye is removed—one instance of where a paternal Government legislates for the workers' welfare without very much gratitude on the part of the operators.

Practically all parts come to the polishing shop because, without a highly polished surface on painted and plated work, imperfections would be very much magnified when the machine was turned out.

When the parts leave the polishers they are not chemically clean, and if they were immersed in the plating bath or enamelling vats before being cleansed to remove all trace of grease, the plating and enamel would peel off. They are therefore thoroughly scrubbed with chemicals to remove the grease, and when dry are placed in plating or enamelling vats.

The former is, of course, an electrical process, and consists broadly of depositing metal (nickel) from a slab of the nickel to the steel. Various methods are used, and some highly ingenious machines have been devised for rapid plating of small articles. The latter are strung on wires like the Chinese carry money, and hung from metal rods which are charged with an electrical current of low voltage. The other pole of the electric current is connected to the nickel slab (anode) and the nickel passes from the anode to the steel to be plated. When the parts emerge from the bath they are dull plated and resemble unpolished aluminium ; therefore, before being sent to the finishers or finished stores they have to be polished again on the before mentioned calico mops or wheels.

The polished work to be enamelled has to be chemically treated to remove all grease, and in some instances baths of heated patent liquid are employed. Some makers are content to clean the parts with a grease removing spirit, like turpentine. When clean, the frame, fork, mudguards, etc., are either dipped in liquid black enamel and hung up to drain or liquid enamel is poured over them. When the superfluous enamel has drained back to the sump of the pan the parts are lifted on hooks (the enamelled surface must not be touched with the hand) and hung in gas heated stoves, where they are baked at a high temperature for a few hours. The very best bicycles receive at least three coats of thin enamel and are stoved between each application. The resulting surface, when cold, should resist blows with a wood broom handle without cracking.

Enamelled and plated parts are handled by the assemblers in the finishing shops in different ways, according to the organization in different factories, but a common method is to have an iron pillar standing up at the edge of the bench, the steering tube of the frame, minus the fork, is dropped over the pillar and the frame is free to swing. The finisher scrapes superfluous enamel out of the bottom bracket threads, and other parts where bearings, etc., require to be fitted, runs a dummy, or easy fitting tap, through the threads, wipes a little oil on the threads and screws in the bearing cups, fits the axle, cotters on the cranks and chain wheel, inserts the seat bolt, ball head cups, attaches the rear mudguard and brakework, and slips the rear wheel into the forks. All this sounds very easy, but in the best work there are small adjustments to be made. Sometimes the plating has adhered where it is not wanted, and nuts and bolts will not screw together easily. To ease the threads the finishers use a hand tapping machine, and a similar hand machine for screwing the outsides of bolts, etc.

Finally, the chain is put on and adjusted, the pedals screwed into the cranks, and the finisher turns his attention to the front forks and wheels, which have been gradually growing to separate front units complete with their mudguards. The rear portion, frame, rear wheel, etc., is lifted off the bench support and dropped over the front fork stem, the whole machine is twisted upside down and the balls of the steering bearings are poured in from a little tool that scoops up and counts the required number of balls. Over goes the machine again and into the top bearing are poured another circle of balls, the ball head clip is pushed on and the locking nut screwed on, and the machine is ready for handlebar, saddle pillar, etc. The accessories are always fitted last, and then the machine goes to the viewer. This man is, or should be, a practical cyclist as well as a practical mechanic. He seizes the machine and after weighing it, entering its number in a book, and feeling the steering, he proceeds to test all the bearings and the chain for correct adjustment, bangs the machine up

Fig. 15

THE FINISHING SHOP IS A VERY IMPORTANT DEPARTMENT OF A CYCLE FACTORY

This photograph is one of the Rudge-Whitworth floors of an extensive building and down and about, tries the brakes, pinches the tyres, runs an eye over all, and finally passes it along to the women and girls who proceed to grease it, wrap strips of paper or butter cloth all over it and tie it up with string. If it is going overseas and the journey is long, the machine may have to be dissembled to enable it to be packed with others in metal lined cases. For passenger train in the British Isles it goes forward wrapped in paper or cloth and for goods train in a crate, either singly or with two or three others.

For transit by goods train in Great Britain each machine occupies a narrow wood crate ; by removing pedals and handle-bar it is possible to squeeze a bicycle into a space of 77 in. $\times$ 23 in. $\times$ 48 in., or $48\frac{1}{2}$ cu. ft. If two or more machines are to travel together the separate crates are sometimes enclosed in another wood crate that is strong enough to hold the lot and to allow it to be slung, and there you are.

CHAPTER VI

PRODUCTION METHODS

THERE are several ways of producing bicycles and all makers do not work on the same lines, in fact, possibly there is no trade where so much diversity exists in production methods as in the manufacture of bicycles.

Omitting the small local assembler who makes up an odd machine or two from finished parts purchased from the big factoring houses, we have, in order of size and importance, the small maker, who builds a bicycle throughout from the raw material; the medium-sized factory owner, who makes most of the parts himself but purchases a number of finished or partly finished components from outside sources; and the very large and complete factory owners, nearly always limited liability companies, who go in for mass production and do all the various preliminary processes on their own premises.

Mass production in the cycle trade is now a very highly organized branch of mechanical engineering. To make a success of cycle building from raw materials a big works has an expert drawing office staff, not only for the designing of bicycles but for scheming the tools which are to produce the parts at the lowest cost. Under this staff work a specialized branch of the engineering trade, who are the tool makers; this staff produces the jigs, templates, dies, etc., used in the departments which are the production shops proper.

Another works staff looks after the progress of the work through the various shops and keeps account of the numbers of parts produced each week, so that an equal number of front forks and handle-bars, to name only two parts, are available when they are wanted. Without their aid chaos would reign, and there might be 1,000 bicycles ready for delivery in a given week and no handle-bars forthcoming at the last moment. Such has been known to occur in factories where the organization is weak.

In a very large factory, where everything is made on the premises, the directors arrange for a production of, say, 1,000 machines a week for six months. The requisitions for material go through the buying department, the designs go from the drawing office and in a reasonable time, if the organization is complete, the parts commence to collect in the various stores throughout the factory. When the stock is sufficiently forward to ensure a regular supply to the various shops; the stores begin to issue the orders to build and assemble, paint and finish, and so the process goes on.

The production of bicycles in very large quantities has brought about a difference in some of the processes of making such parts as frame lugs, handle-bar lugs, fork crowns, crank brackets, fork ends, etc. What are known as pressings are largely replacing stampings and castings. The latter are made in one pair of dies from red-hot steel by stamping the plastic metal into the die or moulding red-hot iron in a mould made of compressed sand ; the pressings are formed from sheet steel between dies, but the metal is treated cold and usually has to pass through more than one pair of dies before it assumes the desired shape.

The multiplicity of dies is necessary to allow the cold sheet metal to be gradually formed ; if it were attempted to bend it suddenly to a sharp radius, it would break or spring back, so the sheet is coaxed, so to speak, to assume the form desired.

Fig. 16

THE DRAWING OFFICE AT THE COVENTRY WORKS OF RUDGE-WHITWORTH, LTD.

It is probably the most important department of the non-productive side of a cycle factory

Dies of this description are very expensive, but when their cost is spread over thousands of parts and the reduced amount of machining is taken into account, then they become remunerative. While the design of bicycles was changing from year to year, the cost of such tools for mass production was almost prohibitive, but the stagnation in pattern has permitted their use to-day with the result that thousands of bicycles are produced, if not wholly, partly from pressings.

Labour has undergone a vast change in the cycle industry during thirty years. About 1890 female labour in the cycle trade was rather rare. A few Midland firms, specializing in parts, employed women and girls in some departments, but on the whole bicycle processes were chiefly done by men and youths. Nowadays there are few large factories where girls and women are not found in practically every department. There are female polishers, enamellers, wheel builders, press minders, platers, in fact every process, with the exception of the skilled mechanical work, can be and is done by women, and well done, too.

The above is a rough outline of what constitutes mass production, as apart from the small makers' efforts, which are on different lines.

The small maker depends very largely on components makers for his output. He buys a frame from one place, or the tubes and lugs ready to build the frame, the wheels complete, minus tyres, come from another specialist ; handlebars and seat pillars from another, and so on. The work in the factory consists largely of polishing, enamelling, plating, and assembling, or as it is more often described in the trade, finishing. Such a factory does not require a plant of machine tools, a designing and progress staff, or much of the organizing ability referred to above. The drawback to the latter method is that the bicycle so produced loses much of its individuality because what the parts manufacturer sells to *A* is also bought by *B*, and, unless extremely large orders are placed with the parts makers, they cannot depart from a standardized product. The bicycles produced in this manner are seldom classed in the same category as the better known articles sent out by firms with a high-class reputation and certain distinctive features, although good bicycles doubtless emanate from factories where little of the actual manufacturing is done.

The manufacture of boys' and girls' bicycles has been widely developed of late. At one time the firm of Townend Bros., Ltd., held almost a monopoly in this particular type of machine. Now several firms specialize in the production of high-grade juvenile bicycles, among them are Humber, Ltd., The Mascot Cycle Co., etc., etc.

CHAPTER VII

THE PNEUMATIC AND OTHER TYRES

THE title of this chapter places the pneumatic tyre first, but before we begin to read how the pneumatic tyre revolutionized the cycle industry and made it what it is to-day, this book would be incomplete without a few remarks on the trials, tribulations and sufferings of those who rode bicycles with solid and cushion rubber tyres and still survive.

As we have seen in Chapter I, the first velocipedes had wheels shod with steel tyres; fortunately for their riders, the saddle was on a long spring, otherwise words fail to explain what they would have suffered.

The next innovation in the way of a non-slipping, elastic tread was to fasten strips of leather to wood felloes. Naturally, leather proved comparatively unyielding and india-rubber was tried. At first it was fastened like the leather in strips, then came the day of wire spoked wheels and solid india-rubber tyres fastened in V or U-shaped steel rims.

The common practice was to cement an endless band of circular rubber to the steel rim with a composition called "packwack," still used to attach perambulator tyres to their wheels. Naturally, the tyres refused to remain in place for long, particularly when wrenched against early-day tram lines, etc. Arrangements to overcome this trouble of the tyres coming out of the rim were patented, notably Hookham's patent wired tyre. A crimped or corrugated wire was inserted in the centre of the rubber tyre and held it in the groove of the steel U-shaped rim by contraction. Tyres in sections were also bolted to the U rims by T-shaped bolts moulded in the rubber, with the tail of the T passed through the rim, being nutted underneath the rim. The average size of solid india-rubber tyres was $\frac{3}{4}$ in., but sizes from $\frac{1}{2}$ in., for racing machines, to $1\frac{1}{4}$ in. for roadsters were used. The larger sizes were, however, too heavy.

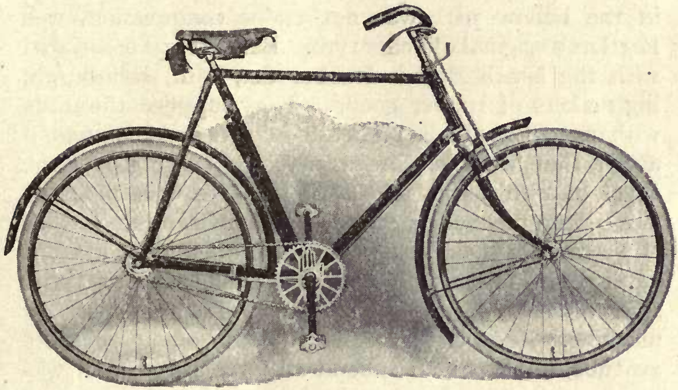

FIG. 17

A ROADSTER SAFETY BICYCLE OF ORTHODOX PATTERN MADE BY RUDGE-WHITWORTH, LTD.

The first attempt to provide more comfortable tyres for cyclists was by the introduction of the cushion tyre. This was a hollow rubber tyre varying from $1\frac{1}{4}$ to $1\frac{1}{2}$ ins. diameter, the hole through the centre varying from about $\frac{3}{8}$ in. to $\frac{3}{4}$ in. If the hole was small the tyre was heavy and the machine ran " dead " ; if large, the sides pressed hard against the edges of the rim and cut through. Some cushion tyres were more like a glorified thick garden hose, and various shaped rims were introduced to obviate the tendency there was to cut through at the sides. The expense of india-rubber resulted in great adulteration of cushion tyres, and although cycle makers of repute paid a fair price to obtain a good article, the makers of cheap shoddy bicycles often used cushion tyres that had very little india-rubber in their composition. The result can be easily imagined.

A tyre on the lines of a cushion tyre, because the air in the hollow part was not under compression, was Bartlett's original Clincher tyre. Bartlett was associated with the North British Rubber Co., Ltd., Edinburgh, big makers of rubber goods. They supplied the trade with quantities of solid and cushion tyres and he patented a tyre that fitted in clinches made by turning over the edges of a steel rim, so that if the tyre were moulded in a certain manner its edges would lock into the clinches and remain firm. The tyre was really just like a modern cover of a pneumatic tyre, but strengthened at the sides till it would support the weight of the rider and machine. The original Clincher tyre had no separate air tube, in fact no air tube at all; the air under it was at atmospheric pressure only.

Early Pneumatic Tyres. The introduction of the pneumatic tyre for bicycles came about in a strange manner known to most people, but repeated here for the benefit of the uninitiated.

In the suburbs of Dublin lived a veterinary surgeon named J. B. Dunlop; he was a cyclist and he had a rather delicate son. Naturally, he wanted the son to derive some benefit from riding a bicycle but he hesitated to allow him to ride a solid tyred bicycle owing to the vibration. The roads around Dublin are not of the best. Mr. Dunlop set to work, and like a lot of other inventors not connected with any particular manufacturing process, he thought out the very master idea that everybody had been looking for, that of insulating the rider at the point of contact of the wheel with the ground.

It will suffice to say that he made an experimental pneumatic tyre in which the air was compressed in an elastic inner tube of rubber provided with a crude non-return valve for inflation and surrounded with a non-stretchable casing of canvas, the latter being covered with an india-rubber tread to take the friction of the road. The rim was very nearly flat in section, and to build the tyre the air tube was partially inflated and laid on the rim; around rim and tube was built the canvas casing by solutioning canvas strips to canvas already solutioned to the metal. Over it all more solution was rubbed in by hand and then came the fixing of the cover, which was also solutioned to the canvas casing and nearly encircled the rim. The edges were finally solutioned down with a thin piece of canvas, afterwards painted to resist the attack of water.

I was not privileged to see Mr. Dunlop's first attempt, but I saw one of the first of these very crude tyres made by the Dunlop Tyre and Booth's Cycle Agency, Dublin, on a tricycle ridden to Coventry by Mr. R. J. Mecredy, the editor of the Irish cycling and motoring papers and, of course, a renowned cyclist.

The tyres were quite unknown, and when the tricycle was left outside a hotel (not in the centre of the city) for ten minutes, a crowd of 400 or 500 people were found pushing each other to obtain a sight of it.

Within a few months everybody in the city knew all about pneumatic tyres. The Du Cros brothers, an athletic family of Dublin, commenced to race on bicycles fitted with them, and very soon handicappers had to give racing cyclists on solid tyres a considerable start if riders of pneumatic tyred machines were entered.

Within a year of the commencement of the serious manufacture of pneumatic tyres no racing man of any pretensions troubled to compete on anything else.

The firm responsible for the manufacture of the first tyres—the Dunlop Pneumatic Tyre and Booth's Cycle Agency—was a small concern in Dublin dealing originally in bicycles. They were joined by the late Mr. Harvey Du Cros, father of the racing cyclists, and his astute business management saw that the concern would have to move to the heart of the industry. Premises were taken in Coventry; previously bicycle manufacturers were compelled to send the wheels to Dublin.

At Coventry commenced an industry which has grown from small undertakings until now the Dunlop Rubber Co.'s factories, etc., occupy acres of ground in Birmingham, Coventry and elsewhere, and an enormous new works is in course of erection near Birmingham.

As at Dublin, owing to the special handling that the tyres required, the cycle makers had to send their wheels to the tyre factory to be fitted, and the Dunlop carts were soon careering about Coventry collecting the tyreless wheels and delivering them, fitted, to the various factories.

The repair of the original Dunlop tyre was a process that the average cyclist undertook with fear and trepidation. A puncture necessitated peeling back the solutioned tread of the cover, slitting the canvas across, withdrawing the air tube and fixing the patch, replacing the air tube, stitching up the slit in the canvas with needle and thread, re-fixing the rubber tread and re-inflating. Cyclists were not all neat hands at this job and wheels would be seen revolving with huge blobs on the tyres, where the amateur sewing and repairs were too weakly done to prevent the air tube bulging out the canvas and rubber cover. Result, inexperienced riders allowed the boil or blob to hit the forks time after time as the wheels revolved, until the friction wore away the retaining cover and bang went the air tube. In those days that meant the assistance of the railway to reach one's destination and oft times a long walk.

Experimenters had, however, been at work and an inventor named Welch brought out a tyre the principle of which is the one still mostly used on modern bicycles. This is now termed the "wired on" to distinguish

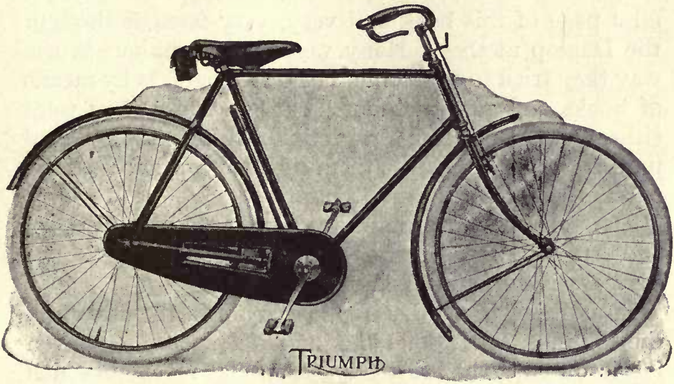

FIG. 18

A "TRIUMPH" ROADSTER BICYCLE WITH OIL BATH GEAR CASE

it from the "beaded edge" or Clincher tyre which was Bartlett's patent.

The "wired on" cover is now made of vulcanized rubber and fabric moulded, under Doughty's process, on to inextensible wires which slip over the rim by reason of the diameter of the wires being so arranged in respect to the rim diameter that when one side of the cover is placed in the well of the rim the other side rises above the opposite edge and will pass over. Then inflation of the air tube draws the two wires, one up and the other down the sides of the rim, and they repose in ledges formed at about half way down the rim sides. There were modifications of the Welch patents, but the one used is one of the original ideas and upheld by the Dunlop Co. against a host of litigation that they were compelled to institute against infringers of their rights.

The names of tyre companies that made tyres for bicycles that were copies of the Welch patents would fill a page of this book and very, very few got through the Dunlop meshes. Many were very ingenious in the way they tried to overcome the master patents by means of hooks and pins and nuts, but gradually they were either bought up, forced to relinquish business by legal pressure brought against them by the proprietors of the patents, or died a natural death.

The original patents have run out now and all and sundry are free to make tyres, but there are comparatively few well-known makers.

In addition to the Dunlop, there are in the first rank the Palmer Tyre Co., who make a specially woven fabric outer cover knitted on a special machine which is a marvellously ingenious piece of mechanism in itself and well worth a study by those mechanically inclined. Then there is the North British Rubber Co., who make the Clincher tyre, Bartlett's original patent. W. and A. Bates, the Avon India-Rubber Co., the Midland Rubber Co., etc., etc.

All the firms mentioned have large works and a very complete sales organization.

I must not close this chapter without a reference to wood rims and single tube tyres. The introduction of single tube tyres in this country was due to Mr. Boothroyd, the inventor of the Facile bicycle referred to in Chapter I.

The simplest method of describing it is to say that it was a glorified hose pipe but thinner in the walls. It was repaired with rubber plugs which were inserted from the outside, and although a very lively fast tyre, it went out of vogue because of the difficulty of making satisfactory repairs. The U.S.A. makers supplied nothing but this type of pneumatic tyre for several years.

The Constrictor racing tyre is so constructed in the wall that the cover can be peeled back away from the fabric, allowing withdrawal of the inner tube and repair on the outside of the tube. Tyres of this description are only favoured by racing cyclists on account of the expert knowledge required to make a proper repair. It is, however, of interest to note that a "speedman" finds it an advantage to carry a spare tyre of this description in preference to using a thicker and heavier type, which requires longer to repair, than to change one of the lighter, thinner kind. The secret of the extra speed lies in the fact that a thin walled tyre is more resilient than a thick one, and when suitably inflated the rapid expansion of the tread, previously compressed by the rider's weight, does not retard the propulsion of the machine so much as a thicker one. A technical explanation of the why and wherefore of this must be sought in theoretical treatises on pneumatic tyres.

CHAPTER VIII

CHANGE SPEED GEARS

One of the devices on a bicycle which has done more to popularize cycle touring than any other, with the exception of the pneumatic tyre, is the change speed gear.

It was shown in Chapter I that the diameter of the velocipede or high bicycle driving wheel defined the method of calculating gear ratio, i.e. the ratio or number of turns of the pedal crank shaft and the rear wheel of a safety bicycle. If the road wheel is 28 ins. diameter, and the gearing multiplies the revolutions of the wheel by two, that is called a 56-in. gear because the wheel circumference travels a distance equal to one turn of a 56-in. diameter wheel ; if the ratio was one to three, the gear would be called 84 ins., and so on.

A change speed gear is a device that allows the gear ratio to be altered to suit the conditions of the road or the riding conditions prevailing at the time. A low gear ratio, one to two, for example, means that the rider is enabled to climb hills better but not faster ; the power of the rider does not vary but the power strokes in pedalling are divided into a greater number of efforts in a given time. The higher gears are useful for normal conditions or for riding with the wind blowing on the rider's back or down slopes when the gradient is not steep enough to let the machine run down quickly by its own weight. Under the latter conditions, viz., with the higher gears in use, the rider's feet revolve the crank axle slower, but the ratio of gearing being about one to two and a half turns of the road wheel on normal or middle, and three to three and a half turns of the road wheel on top gear, the machine moves faster with approximately the same exertion ; or to explain it another way, the rider has no need with a high gear in use to exhaust himself with rapid pedalling as he would do if he wished to ride fast with a normal single gear.

Some racing cyclists disdain the change speed gear and prefer a single gear of medium ratio, but for tourists, and particularly for women and elderly men, the change speed gear is a boon.

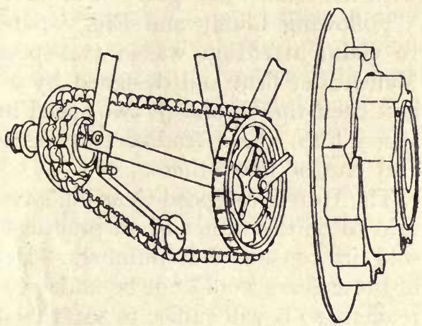

Fig. 19

THE LINLEY AND BIGGS TWOSPEED GEAR

Ever since the days of the first safety bicycle the advantages of a change speed gear have been recognized, but it was not until about 1900 that a practical device was marketed. Previous designs were either too heavy and complicated or their poor construction caused so much friction when the train of gear wheels was in use that cyclists preferred a single gear.

I think it was at the Stanley Show of 1900 that Linley and Biggs exhibited a change speed gear that was made by running a specially shaped chain over chain wheels that were wide enough to allow a lateral movement of the chain to shift it from a small to a big sprocket on the rear hub. This provided a change of speed but it entailed a jockey pulley to take up the slack of the chain because there was no arrangement to lengthen the distance between the chain wheel centres when the chain encircled the smaller sprocket, i.e. when the high gear was in use. To show that Linley and Biggs were very practical cycle engineers, very much in advance of their time, a device resembling their original idea has been patented quite recently, but is too crude to have much chance of competing with the refined hub gears of to-day.

Following Linley and Biggs' patent, the next device to claim attention was a two-speed hub made by a Manchester firm and designed by a Mr. Ryley. There had been the G. and J. two-speed hub, the Planet two-speed hub, the Paradox two-speed crank axle gear, and one or two others.

The Hub Two-Speed Gear Co.'s two-speed hub may be said to be the father of all practical hub gears and was sold in considerable numbers. Detailed explanations of these gears would not be understood by non-technical readers, so it will suffice to say that by means of a train of pinions and a sliding member operated by a rod passing through the centre of the hub axle, the changes of gear ratio are made. The rider moves the rod in and out by pulling on it through the medium of a small lever on the top tube of the bicycle, and a wire which runs over a roller from the lever end along the top tube to the roller and down the side of the back stay. The movement can also be effected by Bowden flexible cable from the handle-bar, thus making it unnecessary to release the handle-bar for changing gear.

While the Hub Co.'s two-speed was being sold and gaining considerable popularity, other firms commenced experiments with hub gears. Notable among these were the Eadie Co., who took up Fagan's patent, the

B.S.A. Co., and the Raleigh Cycle Co., who paid attention to a three-speed hub made under the joint patents of Sturmey and Archer. Ryley, of Manchester, moved to Birmingham and began the manufacture of a three-speed hub at the New Hudson Co.'s works under the name of the Armstrong.

The three-speed hub was now an established favourite, and so rapidly did it gain favour that it was included in the specification of nearly every high grade bicycle on the market.

Armstrong's and the Raleigh Co. (Sturmey-Archer) laid down an enormously expensive plant of machine tools to deal with the gears on a commercial basis, and were able to so reduce the cost of manufacture that they had the trade to themselves. The only other change speed gear that has been retained by a cycle manufacturer is the original bottom bracket two-speed gear made by John Marston, Ltd. (Sunbeam). This is an epicyclic or sun and planet gear on the crank axle and is operated by locking or unlocking a central pinion surrounding the shaft. It is fitted as a standard article by the makers of the Sunbeam bicycle and has the great advantage that it is enclosed in a metal oil bath case and when the gear is in use the pinions revolve at slower speed than a hub gear, and are being constantly lubricated with fresh oil picked up by the chain wheel.

The production of the three-speed hub gear is now confined almost entirely to Sturmey-Archer Gears, Ltd., Nottingham, and the B.S.A. Co., Birmingham, the Armstrong gear having been merged with the Sturmey-Archer gear just before the war.

One might almost say that the production of hub gears is a special trade, because the accuracy required for the making of the parts is certainly more refined than is the case in any cycle factory where ordinary cycle parts are machined. Only by working to the finest limits employed in any branch of mechanical engineering is it possible to produce an intricate piece of mechanism contained in the space of a large sized bicycle hub. The plant, installed originally by the Raleigh Cycle Co., cost thousands of pounds, and cyclists certainly owe this firm a debt of gratitude for making it possible to buy such a beautifully made gear at a moderate price.

Motor-cycle Gears. The history of the change speed gear applied to a motor cycle is akin to that of the bicycle. The early forms were very crude affairs in comparison with the modern countershaft gears as they are termed to differentiate them from their prototypes, which were fitted in the rear hub shell. The motor cyclist very early called for a change speed gear, because his engine refused to give off power unless it revolved at a high speed, and slow travelling on hills reduced that speed.

The first motor cycles were tricycles, and they had gears of the sliding or compound type, then came the Roc gear patented by the inventor of the Wall Auto Wheel. The latter was an epicyclic gear in the hub, the change of speed was effected by locking first one and then the other of two brake drums by means of band brakes.

The first commercially successful gear, in so much that it was marketed in quantities, was the Armstrong, fitted to the New Hudson and afterwards other motor cycles.

Sturmey-Archer Gears of Nottingham followed with a similar hub gear. Hub gears lost favour with motor cyclists on account of the weight of the gear being in the wrong place, and because so many hub gears intended for solo riding were used with side-cars and passengers, and proved unequal to the task of the double work. The modern motor cycle gear is now almost wholly of the countershaft type, and contained in a separate box or case like the change speed of most motor-cars. The Sturmey-Archer Co. and the B.S.A. Co. have specialized in these gears, but many other firms make their own.

Still another popular type of gear used by two firms in particular, Rudge-Whitworth, Ltd. and Zenith Motors, Ltd., is the expanding pulley type. In both instances a belt is used but in the Rudge-Whitworth case both front and rear pulleys expand and contract, and in the Zenith patent only the engine pulley expands and the slack of the belt is taken up by sliding the rear wheel from and to the engine as the call for a low or high-gear ratio is desired.

For a technical treatise on motor cycle gears, I would refer readers to handbooks published by the proprietors of *The Modern Cycle,* Iliffe & Sons, Ltd., 20 Tudor Street, London, E.C.4.

CHAPTER IX

SPRING FRAMES

LIKE every other road vehicle, there have been attempts made from time to time to spring the road wheels of bicycles. Before the advent of pneumatic tyres these attempts were more frequent, but patents in connection with the springing of bicycles have been exploited as recently as 1902–3.

Omitting the early bow spring used to support the saddle of boneshakers, the first patents in connection with spring frames followed the lines of some of the spring frames now employed for motor bicycles. The rear fork was hinged to the frame near the crank bracket and the spring was placed at the top of the fork between the seat tube and the apex of the triangular fork. One of the first of these was, I believe, the Star, in which a rather large volute spring was used. The Whippet spring frame was an ingenious arrangement of toggle joints and springs by means of which the rider was partly insulated from vibration, but the road wheels were unsprung. This frame was introduced just prior to the pneumatic tyre and had a short life in consequence; had the pneumatic tyre arrived several years later the Whippet frame probably would have met with the success its ingenuity deserved.

Sharp's air spring frame was a device which was exploited about 1904–6, and in this system metal springs were replaced by cushioning devices in which the movement of the road wheels was controlled by air alternately compressed and released by an action that is analagous to the movement of a pump. The invention was clever but it never caught the public favour, partly due to increased weight and the average cyclist's objection to complication.

Spring forks were far more common than spring frames, and it is rather surprising that they are almost obsolete on a modern bicycle. Among the pioneer front spring fork inventions may be mentioned the Dunlop. In this design the wheel was carried in jointed links which were connected to the fork blades by interposed spiral springs.

A Nottingham firm, at a later date, made the fork blades or sides like a small carriage spring of two to three leaves of flat spring steel, the flat part of the leaf facing the direction of travel. This form of spring made the machine very comfortable to ride but was said to detract from the rigidity of the drive when the bicycle was pedalled up steep hills ; the blades or leaves were also liable to fracture.

Following the withdrawal of this last type of spring fork the question of springing of bicycles has lain dormant, and shows no signs of revival.

The principal objections to springs from a mechanical view point are that they add weight and complication to the machine ; they interfere with the action of brakes and render them far more difficult to fit ; the joints wear and adjustment devices have to be designed, which are costly to produce, and however well made the joints may be, they are almost sure to rattle.

To sum up, the objections appear to outweigh the advantages of this method of insulating the rider from road shock when the pneumatic tyre absorbs so much of the vibration at the point of contact of the wheel with the road surface.

In addition, the rider, if he be skilful, can act as a natural spring by partly lifting his weight off the saddle and supporting himself to some extent on the pedals.

Particularly does this apply when free wheeling, because if the cranks be allowed to assume a horizontal position, one at 3 o'clock and the other at 9 o'clock, the rider can stand on the pedals and allow his knees to form the joint of a spring, the muscles of the calves and thighs being the springs. A skilled rider invariably adopts this position when free wheeling on rough roads and also instinctively falls into it when pedalling forward, with either a fixed or free wheel; with the former he slackens speed and bears his weight on the rising pedals, so raising his weight out of the saddle; with the latter he allows the machine to over run the cranks, by free wheeling momentarily, and at the same time raising his weight on the stationary pedals.

Motor-cycle Springing. The motor-cycle springing mechanism is a far bigger and more complicated proposition than that of a bicycle. Practically every motor bicycle has a spring front fork, although at one time only rigid forks were obtainable. Increase of speed and deterioration of road surfaces made spring forks a necessity, and no motor-cyclist would buy a machine now without one.

Lately there has been a tendency to spring both wheels of a motor bicycle, the generally accepted design being some form of leaf spring, which permits the rise and fall of the wheel against the action of the spring without throwing the wheel spindle out of its correct position in relation to the transmission.

The drawbacks to any form of springing are the rapid wear of the hinges or joints by which the wheel is connected to the springs and the springs to the rigid portion of the frame, and the bouncing effect that is set up by the uncontrolled movement of the springs.

Springs are also fitted to some designs of side-car wheels as well as to the body of the side-car.

CHAPTER X

THE TRADE AND RACING

THERE is, perhaps, no industry in the country that is connected with a sport or pastime that is or was influenced so much by successes made on its products as the cycle trade.

The manufacturers recognized in the earliest days the value of the publicity gained by an important win on a bicycle of their make and bearing their name and trade mark. The value of racing successes is not now quite so high as in the past, but it still plays an important part in keeping the names of various makes of bicycles before the public eye.

The earliest races that were supported by riders of the professional or semi-professional class were unimportant road events that were contested by men engaged in the cycle industry in some capacity or other, and retained chiefly for their prowess in pushing some particular make of machine to victory. Sometimes they were the actual producers of the machine, but it was comparatively rare to find a really good racing man who combined mechanical talent with a capacity for speed and endurance.

Racing on high bicycles began to attract the attention of the public when proper cycling tracks commenced to appear in various parts of the kingdom. Previous to the construction of cinder tracks some racing had taken place on grass running tracks, three and four laps making a mile. One of the best known of the early cinder tracks was at Stamford Bridge, Fulham, London ; others sprang up at Aston Lower Grounds, Birmingham ; Crystal Palace, Sydenham, London ;

Molyneux Grounds, Wolverhampton ; Belgrave, Leicester ; and many other places. The National Cyclists Union was formed and took charge of amateur racing and some remarkable contests and record results were witnessed by large crowds of enthusiastic spectators.

It is safe to say that the early N.C.U. events were contested by amateurs, but one is treading on rather delicate ground when attempting to give a faithful description of later events or to define the status of an amateur. Much the same difficulty occurs in any sport, so the less said about it the better, except that the men engaged in racing did not worry half as much about the definition of an amateur as they did about the straight riding of those with whom they competed.

The real professional rider, of whom there was, perhaps, no better example than the late Dick Howell, toured the country during the summer months in parties who were under the control of a manager. The latter engaged the track, advertised the racing, and took a percentage of the gate money; it was, of course, a regular money-making public show and did not pretend to be anything different. In the winter the same managers organized indoor races on boarded tracks at such places as the defunct Aquarium, London ; Bingley Hall, Birmingham ; and other towns.

Indoor races were held between these professional teams of cyclists and relays of horsemen, and I believe the late Colonel Cody (Buffalo Bill) once took part in one of these contests.

We received visits from American teams of professional riders who toured the tracks of England and rode against the pick of British "pros." Some of the events were worth going to see, others, I am sorry to say, were not.

With the advent of the pneumatic tyre the popularity of racing increased to a remarkable degree. This may have been partly due to the fact that the introduction of the pneumatic tyre synchronized with the increasing popularity of the safety bicycle, or it may have been caused by the extreme competition that was in existence at the time between rival tyre companies. Previous to the pneumatic tyre the bicycle maker bought solid and cushion tyres from firms who left the advertising of their wares to occasional announcements in trade journals and depended for trade on the reputation they had gained among their customers the cycle manufacturers. Not so the pneumatic tyre manufacturer, who commenced in an astute manner to advertise every win made on machines fitted with his tyres. Thus, the competition that previously only existed among cycle makers was increased by about 100 per cent. Men were racing to advertise tyres just as much as machines.

The tyre trade element in racing penetrated to the important club road races, and when pace making was permissible teams of pace makers were sent out to assist the best men to win. The competition became so fierce, and the speed on the road so high, that the governing bodies were compelled to step in and prohibit paced road races.

All such events are now unpaced, which means that each rider has to make his own pace, i.e. he must not shelter behind another and so gain an advantage by having the air resistance cleaved to enable him to ride in a partial vacuum.

Track racing and road racing are very different, and it is not by any means certain that a successful rider on the track will be a consistent winner on the road. Track racing requires a lot of judgment as well as speed and dash. On the road there is no finessing for position in sprints for the tape, when speedy men are often left behind or shut in by astuter competitors who may be no faster in the final rush but who secured the better position by good jockeying.

Road racing requires strength, speed, stamina, and a knack in climbing hills. Provided the rider is speedy enough there is nothing to prevent him winning important events; he has not to contend with the betting side of the question, which is sometimes rather startling to a novice. There are such occurrences as being purposely upset; luckily, they are not common, and are only instanced to show that while the average healthy youth may indulge in a little road racing every week without considering such eventualities, he who aspires to track honours must be prepared for the worst whilst hoping for the best.

Present day racing comprises track meetings, practically all over the country, every Saturday. Many of these are unimportant. The aspirants to fame should keep a look out for the N.C.U. Championships which are now allotted to various centres. The clubs in London, Manchester, Birmingham, etc., hold various track meetings for races varying from one mile to fifty miles, the longer distances being sometimes paced by tandems. Scotland and Ireland also have championship meetings.

Road racing consists of important events such as the Bath Road C.C., North Road C.C., Anfield C.C., and Midland C. and A.C. fifty and hundred mile races; the North Road C.C. 24 hours race; and other classic events. The speeds in such fifty and hundred mile races as the above reach over twenty miles an hour average, and in the last North Road 24 hours race the winner rode 378¾ miles on the fairly level roads of the Eastern counties in the neighbourhood of Wisbech and King's Lynn.

CHAPTER XI

THE CYCLE BOOM

THE great boom year in the history of cycling and cycle manufacture has had a tremendous influence on the trade, and history has undoubtedly repeated itself in connection with the sale and manufacture of motor cars and motor cycles.

The boom year in cycling occurred in 1895–96, when the popularity of the pastime for fashionable women became an accomplished fact, and there was a sudden rush for bicycles by a class of people who had never previously given the sport a single thought.

Manufacturers became so full of orders that could not be executed that the astute financial company promoter was attracted to Coventry, Birmingham, and other towns, and the cycle-maker, who had up to that time practically depended on financial assistance from local banks and business friends and acquaintances, found that the most tempting offers were made if they would only allow the company promoter to step in and handle their business by offering it for public subscription.

Some of the larger and better known factories were purchased by the financiers and refloated for enormous sums, far above their previous values. Large amounts went down in the prospectuses for goodwill, patents and other items, which were not very tangible as assets when the inevitable slump came.

Money poured into the coffers of men who had done nothing to build these businesses; they had only been astute enough to see that the market was ripe for flotation, and as the public cried for cycle shares they got them. The result of all the flotations and the buying and selling of the various concerns was that a limited few made money and a large number of people, many of them workers in the various businesses, lost their savings of many years.

The unprecedented demand for bicycles was afterwards proved to be a little fictitious, because every dealer ordered three times as many bicycles as he expected to sell with the hope of obtaining about one third of them. When the off-season for sales arrived those fictitious orders were mostly cancelled, and as manufacturers could not force delivery on dealers who, if they had been compelled to take the machines they had ordered long after they were due, would have been unable to pay for them, the cancellations had to be largely accepted.

The result of the flotation of many of the cycle firms meant over capitalization. The prospectuses had set forth that as such and such a profit had been earned on the manufacture of a certain number of bicycles, the unprecedented amount of orders on the books at high prices signified a corresponding increase in the profits, which would be more than sufficient to pay the dividend on a largely increased capital.

Alas, the orders were cancelled, society got tired of the new craze and relinquished the use of a bicycle, and the great slump of 1896–97 rushed on the trade with greater swiftness than the boom of the previous twelve months. Over capitalization meant that many of the older publicly floated concerns and several entirely new firms either reduced their capital by cancelling half the value of their shares or retired voluntarily or compulsorily from the arena.

Two or three very lean years intervened between the slump and the advent of the motor cycle and motor-car.

The motor-car was exploited before the motor cycle in this country, and it was not until about 1899–1900 that cycle makers in the Midlands began to take an interest in the self-propelled machine. The earliest machines were petrol engined tricycles, and from that early commencement the lure of the motor cycle has gradually but surely drawn every important cycle maker to its charms until to-day no important firm is

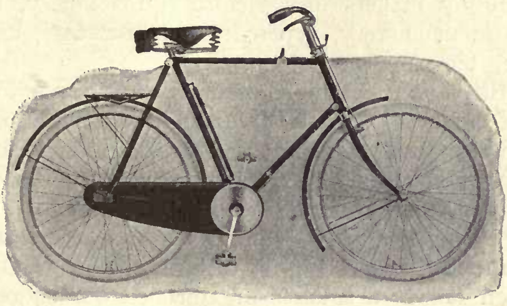

Fig. 20

THE SPARKBROOK ROADSTER

A soundly-constructed machine made by an old-established concern

without a motor cycle department, and in many cases the motor cycle branch has become more important and larger than the making of purely pedal cycles.

The present conditions of the trade are possibly rosier than they have been for some time past. There is an urgent demand for good bicycles and the only drawbacks to a large output are the difficulties in securing regular supplies of the right materials, and the unsettled state of labour generally.

It is estimated that there are about 20,000 employees, men, women, youths and girls, engaged in the manufacture of bicycles and their component parts, exclusive of those who make the accessories such as lamps, saddles, pumps, oil tins, and similar articles which do not come under the classification of a complete bicycle.

The American Bicycle and its Influence on British Trade. There have been American invasions of this country by makers of agricultural machinery, boots, domestic machinery, typewriters, motor cars, and, of course, bicycles.

Of those articles enumerated all have come to stay except bicycles. Various opinions have been expressed as to the reason why American bicycles did not attract popular favour in this country. They were largely advertised, important firms rented expensive shops for retail purposes, and at one time it looked as though the American bicycle would catch on. The attempted invasion failed; a small army reached our shores but it got swallowed up and the officers retired with discomfiture.

The reason may be explained as follows. American makers produce one pattern of any article in large quantities and expect all purchasers at home and abroad to buy what they make. The American bicycles that reached this country were no exception to the general rule. They were made for American boulevards and asphalte roads of cities and were totally unsuited for touring and general riding conditions in this country. The mudguards and rims were of wood, the tyres were single tubes that could only be repaired with rubber plugs (a method not understood in England), the brakes were inadequate for our hilly roads, and the only redeeming feature of these machines was lightness. They arrived at a time when home manufacturers were at their wits end to supply the demand or practically none would have been sold, and those that were disposed of mostly caused trouble and loss of custom to the retailers.

To-day, American manufacturers have changed their tactics, and although no very serious effort has been made to further the export of bicycles from the United States to Europe, the trade "over there" have not lost sight of the possibility of capturing some of the European markets, if not our own British one. Enquiries have been instituted by the American Chamber of Commerce as to the pattern of machine most likely to be demanded, the names of large buyers, their methods of payment, etc., etc. It would be, therefore, unwise to say there is no possibility of a recurrence of American bicycle exports to England; the machines will, however, require to be vastly different from those that were first sent over.

At the time of writing there is an import duty on foreign bicycles of 33⅓ per cent. *ad valorem,* which constitutes a bar to American exports and it is questionable if, when this tariff is removed, American bicycles could be sold in this country at a profit. By the time our Government has decided to remove the tariff, English cycle makers may be able to reduce prices which, of course, like the cost of other manufactured articles, have gone up considerably.

In 1914 excellent English bicycles could be bought for about £8 8s., and if such prices ever return when tariffs are removed, then I do not imagine there will be very much chance for American machines in this country.

CHAPTER XII

ROADS IN GREAT BRITAIN

As an inhabitant of the county of Warwickshire, I have always had an idea that the comparatively level roads of the districts surrounding Coventry and Birmingham had something to do with the early popularity of the bicycle.

It is inconceivable that had the heavy, hard running machines of the early days of the industry been exploited in Devon, for example, they would have attracted the attention of the mechanical minds that evolved the perfect bicycle we ride to-day.

The modern bicycle, had it been possible to put it on the road in its present form at one jump, would have been popular anywhere and at any time, but with the bone-shaker it was different.

Many years ago the surfaces of the Midland roads around Coventry and south of Birmingham were much better than they are now; the hills, except in the Edge Hill district, are not abnormally steep, and close to Coventry is the famous London road with a level stretch for six miles or more. It was on such highways that the high ordinaries were perfected and the safety bicycle tested and exploited. They were both tested and tried out in other places, but Coventry was the home of the bicycle, and without fairly level and good roads I am sure the early attempts would not have developed the enthusiasm of their makers to the same extent.

The use of the bicycle expanded from Coventry and the Midlands like a ripple on a pond spreads from the spot where a stone is thrown into the water. The

Warwickshire roads had therefore a good deal to do with the popularity of the pastime in early days.

The classic roads of England and Wales are the Great North Road, the Bath Road, the Holyhead Road, and the Brighton Road. Mr. C. G. Harper has given us interesting descriptions of these great highways in his books, named after the roads themselves, also narrative and data referring to each. I only propose to refer to them from the cycling view point, and would advise those who wish to acquaint themselves with their history in detail to read the Harper series.

Two other interesting roads of value to cyclists are Watling Street and the Fosse.

On the Great North Road are started the famous 12 hr. and 24 hr. road races of the North Road C.C., but as the club only utilize the classic highway as far north as Norman Cross, near Peterborough, the route for their race extends mostly eastward into the adjacent fen country. The London-Edinburgh record breakers ride on this road from the G.P.O., London, to a point near York, where the highway ceases to be known as the "Great North Road" but it is, of course, the route by which the old coaches travelled between Edinburgh and the metropolis.

The Bath Road C.C. claim the western highway as their special hunting ground, and there is a recognized Bath and Back Record, the time of which is occasionally reduced by some expert rider who tackles the journey under favourable conditions. There is no recognized road record for the Holyhead Road, but as it is the main artery from London and the Midlands into North Wales it becomes almost a necessity for cyclists to make its acquaintance when travelling to the watering places of the North and West. Leaving London it occupies the site of Watling Street (is Watling Street in fact) until at Weedon it branches to the left and passing through Coventry, Birmingham, and Shrewsbury, enters Wales near Chirk. It then traverses some of the most famous beauty spots of North Wales, crosses the Menai Straits on Telford's suspension bridge, near Bangor, and terminates with a twenty-two mile nearly level stretch across the island of Anglesey.

As regards the Brighton Road there are many ways to Brighton, the classical record route being by Purley, Horley, Crawley, and Handcross. The Brighton Road was associated with the earliest bicycle performances, when plucky pioneers trundled bone-shakers there in the day. Relay rides were also a feature of the days when cyclists showed they could beat the time of the Brighton four-horse coach. Innumerable cycling records have been made on the Brighton Road, but the extension of London southwards and Brighton northwards entails so much traffic riding that very few attempt the performance now.

Watling Street is probably the most ancient road in the Kingdom. It is supposed to have existed prior to the first Roman invasion, but it was the Roman conquest that caused it to be improved and extended. Originally, it stretched from near Dover to Wroxeter and probably north to Chester or Carlisle. Cyclists riding from Dover to London follow the line of the old highway by what is known to-day as the Dover Road; the Street went right through the heart of London, issuing at Edgware. Near St. Albans, the Holyhead or Birmingham road makes one division from the old Roman track, but returns to it and makes use of Watling Street all the way to Weedon. Here it turns to the right, away from the modern road, and, with two breaks (where the Street crosses fields), continues in an uninterrupted line through Atherstone to a point near

Lichfield. It is picked up again near Brownhills and continues from there to Wroxeter, between Wellington (Salop) and Shrewsbury.

It is largely used by London and Birmingham cyclists as a through route to the gate of North Wales (Shrewsbury), partly because it avoids practically all large towns and on account of its occupying high ground from which extensive views are obtained.

The Fosse, the second ancient road in importance, once known as a Royal Road or King's Highway, stretched from the Lincolnshire coast to a point in Devon near the mouth of the river Axe. Cyclists use the modern Fosse from Lincoln to Newark-on-Trent, Bingham, Syston, Leicester, and Narborough, almost to the Warwickshire boundary. They will find it rideable, although mostly a gated road through Warwickshire, and it emerges as a highway again near Halford Bridge. From Halford it is the main road to Moreton-in-the-Marsh and Cirencester. Below Cirencester it can also be followed to Bath and beyond, but is not a rideable road beyond South Petherton, in Somerset. Both Watling Street and the Fosse are best known for their directness in making from one point to another, but they are not straight, as is popularly supposed, except in the sense that they were laid out in straight stretches of about nine miles or so in length between pre-determined spots.

The popularity of cycling in this country is due largely to the excellent network of roads we possess. The surfaces, it is true, are fast deteriorating owing to abnormally heavy traffic which they were not constructed to bear; nevertheless, Great Britain has probably better roads, from a cyclist's view point, than any other country in the world. When I say better I do not allude to surface alone, but to their suitability for the tourist and the follower of the pastime generally. Our British roads and lanes are not made in straight lines like many Continental roads and by-roads; consequently they are more interesting to traverse and seldom monotonous. In fact they are the reverse, because every turning brings some interesting view before the rider's eyes. There is nothing so monotonous when cycling as to follow a perfectly straight road. Even long distance airmen will tell you that flying in a straight line for hour after hour becomes terribly irksome, and they often yearn for the motor or cycle and the turnings and twistings of the road.

The increasing amount of motor traffic and the possible conversion of some main through routes for the use of motor-cars alone has caused the Transport Ministry to consider the question of making special cyclists' paths. Whether these ultimately will be constructed is conjecture at the time of writing, however, such paths for the sole use of cyclists are quite common in some parts of the Continent, notably in Belgium, Holland, and France.

In the rural districts the paths are used by cyclists and pedestrians together, and it is only near populous parts that the special cyclists, paths, are reserved for their exclusive use.

CHAPTER XIII

THE WEIGHT QUESTION

THERE is no subject in connection with cycle making that has been more discussed among riders and makers than the all important weight question. It is obvious, without much explanation, that where human power alone is employed for propulsion the weight of a bicycle is vital. It must not, however, be imagined that the lightest bicycle is the easiest to propel in all cases without other consideration. A bicycle frame may be so light that instead of resisting the torsional and other strains imposed on it by the rider it will "whip" and so cause power to be lost between the bottom bracket and the rear hub by setting up friction in the transmission.

Hubs and bearings that are too small cause undue friction by binding and so fail to roll easily. There is also the danger of making parts so light that they are prone to breakage.

There has been a great tendency during the past few years to make bicycles unnecessarily heavy. This is accounted for in various ways, the explanation being somewhat difficult to arrive at.

The chief reason is that makers with a reputation at stake like to be on the safe side, and they argue that it is unwise to send out light machines for indiscriminate use. All riders do not treat a bicycle in the same manner, and where *A* would use a feather-weight for years without meeting with breakage or other serious trouble, *B* would smash or otherwise damage an ultra light machine in the first few hundred miles.

There is an art in riding a light bicycle, it has to be ridden gently over bad sections of road. The rider must not sit like a dead weight in the saddle and free wheel down hill at full speed and rely on the brakes to stop him suddenly.

Light, thin tyres are, of course, much more easily damaged by sharp stones, although they do not, as is supposed, puncture more readily; that is a question of luck.

A light weight touring machine for an average weight rider should be procurable at 30 to 32 lbs. with three-speed hub gear, brakes, mudguards, semi-racing saddle, and rat-trap pedals, but minus bell, bag, and lamps. Unfortunately, the great majority weigh between 38 and 40 lbs., and some are much more.

If a tourist wants greater comfort and reliability than can be obtained with such a specification as above he must be prepared to push along about 45 to 50 lbs. Many full tourist machines with heavy spring saddle, gear case, $1\frac{3}{4}$ in. tyres, wide rubber pedals, and three-speed hub, weigh quite as much as 50 lbs. and sometimes more.

Comfort must be sacrificed to some extent to secure lightness, and it is for the individual to decide what he thinks will best suit his or her requirements.

Generally speaking, the clubman will have a fairly light machine; he is usually a practised rider and knows how to humour his mount. Club life tends to increase the demand for lighter machines, because the newly-fledged member with a heavy bicycle soon finds that he is outpaced, particularly up hill, by men of less strength but equipped with a machine perhaps 15 to 20 lbs. lighter than his own.

Omitting track racing machines, there can be said to be four classes of bicycles used on the road.

1. *The road racer.* An absolutely stripped machine,

without brakes, free wheel, or mud guards. Fitted with very light tubular tyres on wood rims and the lightest possible saddle. Weight varies from 20 to 25 lbs.

2. *The light roadster.* This type has $1\frac{3}{8}$ in. tyres, steel or wood rims, one brake, free wheel, celluloid or very light steel mudguards. A single gear is used and rat-trap pedals. Weight 25 to 30 lbs.

3. *The light touring roadster.* The specification of a typical model will be $1\frac{3}{8}$ to $1\frac{1}{2}$ in. tyres, steel rims, heavier mudguards than No. 2, a three speed hub gear, a slightly heavier saddle, two brakes. Weight 30 to 35 lbs.

4. *The touring roadster.* This type is sometimes facetiously termed a Dreadnought. Its equipment will be : 28 in. wheels, $1\frac{3}{4}$ in. tyres, two brakes, metal or leather gear case, three-speed hub gear, three-coil heavy saddle, wide rubber pedals, splashguard, and luggage carrier. Weight up to 50 lbs.

None of the above includes accessories such as bell, lamps, toolbag, touring valise, or other impedimenta which may be necessary when touring, and which may add from 5 lbs. to 7 lbs. to the weight.

Some riders will start out for a week's tour and ride one of the lightest of bicycles, say, the No. 2, and by sending on luggage by post or rail manage quite well and be happy and comfortable. Another would not think of going out for a week-end ride without carrying his own luggage on a No. 4, with lamps, bell, toolbag, etc.

The speed of the rider of No. 2 would possibly average 12 miles an hour, whilst he on No. 4 would be quite satisfied with 8 miles per hour, or even less.

CHAPTER XIV

THE BICYCLE ON THE CONTINENT

A BOOK on the cycle industry would hardly be complete without a chapter on the Continental type of machine and some reference to British cycles used on the Continent.

The French are, perhaps, the next largest users of the bicycle to the British. The pastime has made great strides there in the last ten or twelve years. Races are extremely popular with Parisian crowds and they throng weekly to both winter and summer tracks, the former being covered in to protect them and the spectators from the elements.

The average French cyclist is rather different from a British rider; he is seldom a tourist and appears to follow the pastime more for the sport of racing than riding from town to town on touring bent. The French bicycle is therefore, as may be expected, largely of the road racing type. It is more often minus brakes, mudguards and similar fittings, has light wood rims, small light tyres, and no free wheel. Some of the road machines used in the neighbourhood of Paris and other large cities are marvels of lightness. Their riders adopt a racing attitude, and so noticeable is the difference between French and British riders that the latter's nationality would be known at a glance by their more upright position in the saddle.

The free wheel and the three-speed hub had been in use for years in this country before French makers took any notice of either. The French mechanic is most ingenious and had designed and made many different types of change speed gears for bicycles, but none caught on, and now if a change speed gear is specified by a French rider it is usually a British Sturmey-Archer that is supplied, if and when obtainable. On the other hand, many British racing cyclists favour a certain type of French racing bicycle which, in small numbers, is being imported into this country. British touring bicycles are very much admired by certain classes of French riders and they often pay very high prices for a British made machine, but generally speaking the trade is small on account of an almost prohibitive import tariff on bicycles of about 1s. per pound weight.

At one time the leading British cycle makers all had big sales depots in Paris, but the Government, goaded by the French makers, gradually squeezed them out one by one by raising the tariff higher and higher as the French cycle makers' production facilities increased.

History is repeating itself in regard to motor cycles, and several British firms opened agencies in Paris before the war. It is expected that their fate, in due course, will be that of the pedal cycle makers.

With regard to other Continental countries the British bicycle is favoured everywhere by those who know what a bicycle should be. Since the war it is, however, very difficult to speak confidently of the future. Russia, Spain, Sweden, Norway, Denmark, etc., were all large buyers of British bicycles up to August, 1914, and doubtless will be purchasers again when conditions are more settled and our home and colonial trade is supplied.

In pre-war days Germany conducted a big business in bicycles in all the Continental countries, and will no doubt make every effort to restore those connections to their former proportions. At the time of writing, Germany is very short of rubber for tyres, but that will not prevent the exportation of bicycles without tyres, provided the German makers can obtain sufficient supplies of other material such as steel tubing, saddle leather, etc. The rate of exchange is against Germany at present and likely to be for some years, so that it is almost useless to make any comparisons that are likely to be of value.

Touring on the Continent. It is the ambition of almost all cyclists to make one cycling journey to the Continent. The change of scene, customs, dress, and language alone repay the rider for any inconvenience that may be experienced, without counting the old world towns and cities that may be visited in France, Belgium, and Holland, to name the three countries most easy of access from our shores. The Cyclists' Touring Club, Euston Road, London, N.W., work in conjunction with similar associations in the countries named and advise members as to routes, hotels, customs duties, and other particulars necessary to know before undertaking a Continental tour.

CHAPTER XV

MILITARY AND OTHER SERVICE BICYCLES

THE advantages of a bicycle for military purposes have been advocated ever since the introduction of the safety, and a branch of the old volunteer service, followed later by the Territorial Army, has always had a cycling section or sections attached to it. The War Office had not been too enthusiastic on the subject until the Great War of 1914–19, when the Cyclists' Section became a recognized and valuable unit of Kitchener's Army, and the War Office placed very big orders for bicycles with many of the largest firms in the industry.

In the old days the cyclist sections were attached to volunteer regiments all over the country, but the Government gave very little, if any, assistance in the purchase of the bicycle and made no attempt to standardize the machines—a very essential thing where any article is used for military purposes.

The cyclist sections paraded at the usual annual camp meetings and engaged in manoeuvres, some of a highly instructive description to the men engaged and authorities alike; all honour and praise to those who worked hard, against strong opposition at times, to prove the handiness and extreme mobility of a soldier when mounted on a bicycle.

Various forms of military machine saw the light some years ago. One was a four-wheeler, or quadricycle, propelled by two or more men and carrying a machine gun; another hauled a small gun or machine gun behind, and was propelled by riders seated tandem or in fours. This was mostly during the days of solid or cushion tyres; with the advent of the pneumatic tyre military cycling was mostly confined to the use of bicycles of the solo pattern.

Carbines or rifles were carried on the machines in much the same manner as they are to be seen in the Army Cyclists Corps to-day.

In war the advantages of a cyclist corps are that a small body of men can push forward to reconnoitre and act as a scouting party; where roads exist, they can, with the aid of a bicycle, cover about three times the distance of foot soldiers and yet be fresh and ready to engage in a skirmish. The bicycle enables men to push forward and make camping arrangements in advance of the main body, and to carry out multifarious duties that in other cases would entail the use of horses which might, by reason of the noise they create, cause their presence to be known to an enemy.

Modern cyclists who carry out military duties recognize that the bicycle is only suitable for certain purposes, and that in some instances it would be only an impediment. Having recognized the failings and advantages of a bicycle in war, it will probably be more largely used than ever in the future by military authorities of this and other countries.

As mentioned earlier in this chapter, the War Office placed huge orders for bicycles with the cycle manufacturers of the Midlands soon after the war commenced in 1914, and bought up all the available suitable stocks they could obtain. Thousands of these machines went to Flanders and France and other overseas countries. Thousands came back to this country and were sold by auction along with those from home camps which were no longer required. These sales undoubtedly affected the retail trade in bicycles throughout the country.

The Continental army authorities, particularly in France, have long recognized the extreme practicability of cycles in war, and the French army have largely adopted a bicycle with a folding frame made by one of its largest and best known manufacturers. This machine, when folded, can be slung across a soldier's back when the ground is too broken to allow a bicycle to be ridden. Thus, the French soldier-cyclist is supplied with a rapid means of transit, and whole companies are equipped with these folding machines and move very rapidly from place to place.

If the Postal Service of the country does not, at the moment, rank equally in importance with the Military Service, it is nevertheless most essentially a branch of the Government of the country, and it makes very large use of the bicycle and the tricycle in the collection and delivery of letters, parcels, and telegrams.

Rural postmen, postwomen, and telegraph girls and boys would be lost without bicycles to carry them swiftly from village to village, and if they were to wake up some morning to find themselves deprived of their use they would, perhaps, appreciate them more than they do now.

The G.P.O. employs a special staff to control its bicycle contracts, to supervise and inspect their manufacture and repair, and generally look after its interests at the factories it favours with its contracts. The cycles used by the G.P.O. are bicycles for telegraph messengers, and postmen, and in some towns carrier tricycles, with baskets in front, for collection of letters from suburban pillar boxes and branch offices. These machines are painted or enamelled the familiar G.P.O. red, and when in dock for any serious repair they are sent to a central depot for attention. Minor repairs are dealt with by local cycle mechanics acting under instructions from the postmaster of the town or district.

Most of the machines have to be capable of resisting somewhat rough treatment, and it is surprising how well they survive it.

The Postmaster-General, like many other Government officials, does not enter too deeply into details in connection with his department, or he would know that a proper dry housing for bicycles is essential if they are to be kept in good condition, and an occasional cleaning and oiling, other than the desultory attention they receive at the hands of the staff who ride them, is as essential to their well-being as to any other piece of machinery. In the meantime, any odd corner out of the way is good enough for the G.P.O. bicycle.

CHAPTER XVI

IN THE FACTORY

THERE are practically two different types of factory in the cycle trade, one where the machine is made throughout from rough stampings, castings, unpolished tubes, etc., the other where the machine is assembled from parts produced in component factories. The difference between the two is that the first possesses a much larger plant than the second, because all the machining operations have to be done in the former case, whereas in the latter the plant consists mostly of enamelling, polishing, and plating conveniences and sundry bench tools and jigs.

Broadly speaking, the first class of manufactory has a much larger staff and is confined to the production of high-class machines, which are designed and made throughout on the premises. Such machines are distinctive in appearance and their makers do not sell the parts they produce to assemblers, so that their special features cannot be copied. Naturally, a machine of this class is more expensive and, generally speaking, will command a higher price on the second-hand market. The reason for increased cost is not far to seek. The operatives who produce the machines are better paid, there is a staff to pay, managers, clerks, foremen, draughtsmen, storekeepers, etc. Broadly speaking, the larger the works the cheaper it should be able to produce, because 1,000 machines per week can be made with the same staff, or approximately the same staff, as is required for 500 machines per week.

Arguing on these lines, the bicycle produced in a factory where all the parts are made from rough material should be obtainable by the public at a less figure than one put together by an assembler. However, this is not always the case, because the assembler often works himself, is perhaps assisted by relatives, and their time is not calculated at the same rate of remuneration as prevails in a modern factory. Again, the assembler's output is very small; he can, and does sell all he can put together practically without advertising costs, depending on personal recommendation.

Several large factories are now devoted almost exclusively to the production of bicycles for the trade, i.e. their owners cut off all advertising and publicity charges, reduce the expenses of their staff and other items to a low ebb, and undertake contracts to supply the large stores, co-operative societies, and others with bicycles that are sold under the trader's own name although he or they may have no factory. On the whole such machines are of a rather inferior grade, they are made to sell at a price and cannot be produced with the same care or with the conscientious spirit of a manufacturer who has a reputation to uphold.

The fact that the purchaser who makes the contract for a quantity of bicycles is in a position to go elsewhere for a cheaper line at any time detracts from the *esprit de corps* that should exist among the staff of a large factory, and as they know that at any period the contract may be taken to another firm, they naturally lose interest in their work. Altogether, the maker who supplies the trade is in an unenviable position—he is not building up a business for himself, but adding, if his machines are good, to the lustre of others who only consider him so long as they are able to grind down his price to their required level of cheapness.

There is a great temptation in factories where machines of this description are made to cut the wages of the workers to secure contracts, and altogether it is rather a sordid sort of business without much to live for except, perhaps, cutting out a competitor by fair means or otherwise.

On the other side of the picture there is much that appeals to one in a factory of the best class, where the

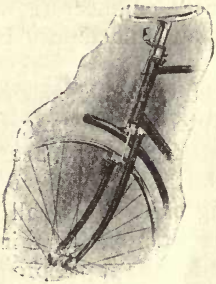

FIG. 21
The 'Triumph" resilient front fork, in which the fork blades are arranged to provide a certain degree of elasticity

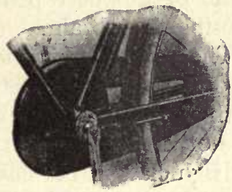

FIG. 22
In this type of "Triumph" bottom bracket the centres of the two shafts, pedal axle and rear hub, are increased or decreased to adjust the tension of the driving chain

directors or owners have a pride in putting their trade mark on every machine that leaves the works. The staff and workers have, I feel sure, from personal experience an increased interest in their daily task, quick to resent any slur cast on the productions with which they are so closely allied. In most of the best factories I have had practical experience that this state of affairs exists, despite what may be written and said about the extremist views, commonly called Bolshevism.

In a large factory the organization of a cycle producing staff is as complicated and efficient as in any other branch of modern mechanical engineering. The innumerable parts of a bicycle render the organizing of production in large quantities a question of brains and system. Time was when engineers in some other branches rather looked down on cycle factories as the home of the inefficient, but the trade journals of the mechanical world have recognized, more particularly during recent times, that a high-class cycle factory possesses some of the best brains in light mechanical engineering, and some of the best plants of tools and machinery it is possible to obtain.

The parts of a bicycle are produced with such accuracy to-day that every detail is absolutely interchangeable with another if the machine emanate from a firm bearing one of the well-known names in the trade.

High-class firms have a drawing office where all the details are worked out on paper to fractions of an inch, and here are designed all the tools for the rapid production of the parts with a mathematical accuracy that ensures easy fitting in the shops. Nothing escapes the vigilant eyes of the head of this department who, in conjunction with the tool room manager, is responsible for every part of a fresh design going together with smoothness and precision.

Then, when production is proceeding, each part is inspected by viewers. This department is a most important one, and in a high-class factory is always so regarded. The viewer may in some cases be quite a subordinate, but he or she is provided with most accurate gauges which are tried on every part ; with lightning like quickness the gauge detects inaccurate workmanship, an error or wear of tools, and back go the faulty parts to the producer to be rectified or they may, on detection, have to be scrapped altogether.

It is only by such means that a perfect bicycle can be produced, so far as interchangeability is concerned in one factory. There are, however, standards of production that enable all the manufacturers in the trade to work to fine limits on certain parts that have been accepted by the Engineering Standards Committee as standards.

Thus, tyre rims have been standardized so that any make of tyre cover will fit a standard rim. Certain threads on screws, nuts, spokes, pedal pins, etc., are standardized, yet much remains to be done in this direction.

Manufacturers are accused of apathy in the direction of standardization of parts because there is no great desire among them for *A's* parts to fit *B's* machine. Various reasons are assigned for this reluctance, among them that makers could not charge what they liked for certain screws, nuts, etc., if one could buy *A's* and *B's* nuts in open competition to fit either make of machine indiscriminately.

Personally, I do not attach much importance to this view because the supply of repair parts and replacements is not a lucrative part of a big cycle factory's equipment and may be most unremunerative.

I consider the greater problem is that *A* may have a very fine tool plant and he is not disposed to scrap it or give it away to enable him to adopt *B's* standard and vice versa. Also, it is unwise in the case of a really high grade bicycle to allow any tinkerer in a country town to fit standard screws, nuts, cups, cones, and other parts to a carefully made machine, for the cups, cones, etc., may be standard but yet inferior to those that were originally fitted.

CHAPTER XVII

ACCESSORIES

UNDER the above heading are all the parts used on a bicycle that are not catalogued with the machine under its specification and price. Also, one might say, saddles, pedals, and tool-bags are accessories ; these are always included in the price of a bicycle, yet bells and lamps are seldom, if ever, thrown in. Doubtless there are good and sufficient reasons for this method of trading, although one or two manufacturers did make an attempt some years ago to initiate the method of selling a bicycle complete and ready for the road. The chief reason for selling sundries apart are that individual taste differs : some will equip the cheapest form of bicycle with expensive lamps, bell, luggage-carrier, etc. ; whereas others will have the very best bicycle obtainable and do not mind cutting down cost in the equipment.

The manufacture of accessories is a separate branch of the industry, and has, like the actual cycle production, grown from small businesses to the very large factories that are now solely devoted to such articles as saddles, bells, tool-bags, lamps for oil and acetylene gas, tyre pumps, and a host of other articles that may be seen displayed in the windows of cycle and accessory depots and shops

The two most important accessories—lamps and saddles—were quite early a separate branch of the trade. To Mr. John Harrington is probably due the earliest introduction of a spring bicycle saddle : it was known as Harrington's Cradle Spring Saddle and, as will be seen by the accompanying illustration, was composed of a steel wire frame, with the now familiar leather-blocked top extending from peak to cantle. The Harrington saddles were manufactured for many years by Messrs. William Middlemore at Coventry and Birmingham, Middlemore saddles being still manufactured in the heart of the cycle industry at Coventry; but the "cradle" design is no longer employed. Most

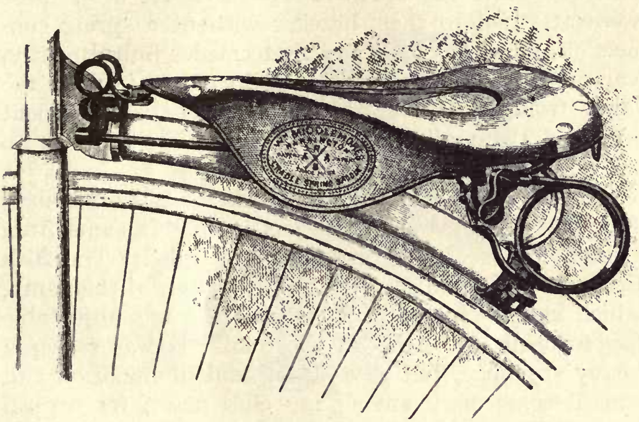

FIG. 23

THE HARRINGTON CRADLE SPRING SADDLE, FITTED TO THE BACKBONE OF A HIGH BICYCLE

cycle saddles are, however, stretched on a wire frame, either coil springs of the horizontal or vertically-wound type being used to support the leather.

Lamps used on high bicycles were constructed to burn oil: they could not be carried on any fixed portion of the machine whence they could throw a light on the road, so one of the pioneer lamp makers—Salisbury or Lucas—introduced a hub lamp which swung suspended from the centre or hub of the large front wheel between the spokes. As may be imagined, the bearing at the top of the lamp, which opened to embrace the hub spindle, very often fitted a little tight, or the method of adjusting it went wrong ; then the lamp stuck and rotated with the spindle.

With the introduction of the safety bicycle, head lamps became the order of the day. At first, these were attached to their bracket without a spring connection, or spring back as it is termed. Subsequently, various spring devices were brought out to insulate the lamp from vibration ; but the present arrangement survived them all, and is sufficiently well known to need no description.

Somewhere about 1888 to 1890, so far as I remember, I bought my first acetylene gas lamp. It came from United States of America, and was called " The 20th Century." I have secured an illustration of this lamp, which had no spring back, although it was adjustable for focusing the light on the road. It was rather a heavy specimen, but gave a splendid illumination and caused some envy among my club mates for several weeks. The principle of gas generation, by water dropping on the carbide from the top compartment behind the lens and burner carrier ; the carriage of the carbide in a vessel below the water reservoir ; and the adjustment of the feed of water by a screw-down needle has not changed from that day to the present time. The only addition has been the spring back for cycle lamps and a separate generator for motor cycle lamps.

In the separate generator type, the gas is conveyed by rubber tubing to the burner of a separate lamp from a separate vessel holding water and carbide. Greater carbide and water-carrying capacity, heavier lamps, and consequent increased weight caused the lamp and generator portions to be divided, because it was found that heavy lamps of the self-contained pattern broke the lamp brackets.

In addition to oil and gas lamps, candle-burning lamps have been tried, but were not popular on account of the poor illuminating power of a candle and the propensity they had to throw melted wax on to the lamp glass, thus obscuring the light.

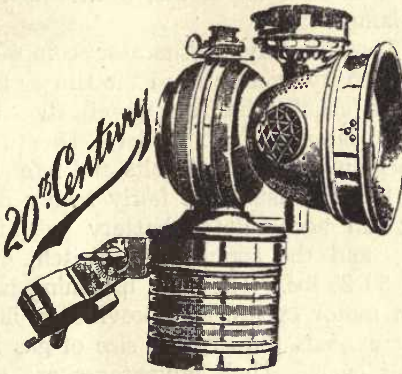

FIG. 24

AN AMERICAN GAS LAMP

The first of its kind to be used on cycles in England

Electric lamps for cycles and motor cycles are of three descriptions: (1) Those where the current is taken direct from a dry battery or accumulator; (2) where the current is derived from a generator which illuminates the lamp direct without the intervention of an accumulator; (3) the motor cycle type with generator or dynamo (a separate unit or combined with the magneto, and termed a magdynamo), which charges an accumulator and whence the current, so held in reserve, goes to the lamp or lamps. (This last is a miniature generating set as used on motor-cars.)

Electric lighting for cycles usually entails greater weight than oil or gas lighting, and is a less powerful illuminant ; but it is cleaner and handier. Acetylene gas is, at present, the most powerful illuminant for its weight.

No. 1. The battery type has a dry cell or wet battery carried in a case on the frame, from which the wires go to the lamps.

No. 2. The direct-type generator comprises a tiny dynamo driven by friction from the rim or tyre of one of the wheels (usually the front wheel), the wire passing direct to the lamp or bulb holder. The tiniest bulbs are used, seldom exceeding 4 volts and more often less.

No. 3. This consists of a fairly heavy dynamo or generator ; an accumulator battery weighing up to 15–20 lbs. ; and the connections, switch, etc., which may total 30–35 lbs. They are becoming increasingly popular on motor cycles, and provide an illuminating power that exceeds the average size of gas lamp used on a motor cycle. Their advantages are cleanliness, and the fact that if the battery is attended to and the machine is in fairly constant use, the generator maintains a supply of current in the battery which is always available, without the mess connected with the cleaning and recharging of acetylene generators.

Such items as tool-bags, luggage panniers, and cases, and similar accessories, made of leather, fibre, etc., are generally made by the saddle firms.

Specialists in celluloid and leather look after the manufacture of tyre inflators, handles, gear cases of leather, and celluloid and similar goods.

There are specialists in many other small accessories, too numerous to mention ; in fact, the accessory trade is even more subdivided than the making of the actual machines. If the various processes were dealt with in detail, it would require very much more space than there is at my disposal to touch on only the fringe of each one.

CHAPTER XVIII

PIONEER RIDES

NOTHING has, perhaps, done more to advertise the bicycle and the assistance it provides than the long distance pioneer rides of years ago, when intrepid cyclists set out to cross the Continent of Europe or to make a tour of the world, using a bicycle wherever possible.

Among such notable performances are the late R. L. Jefferson's ride from London to Constantinople; Charles Terront's journey from Petrograd (then St. Petersburg) to Paris; a journalist's tour with two other cyclists round the world, etc., etc.

The writer was personally acquainted with the late R. L. Jefferson, and accompanied him on a 30 mile ride on the Saturday before he left England for Constantinople. Jefferson rode a Rover bicycle and did not encumber himself with a vast amount of luggage, relying on being able to obtain what he wanted as he went along. An account of the performance that was published at the time showed that in many parts of Eastern Europe there were no roads, such as we know them, only cart or mule tracks deep in mud or loose with dust. Jefferson had many adventures on the way, but eventually reached his goal and repeated the performance at a subsequent date, using a small single cylinder Rover motor-car.

Terront's ride from Petrograd to Paris was done in 1893, and accomplished in a few hours more than fourteen days. He travelled through Russia, Poland, Germany, Belgium, and France, and was accompanied during part of the time by pacemakers on bicycles. Moreover, his manager and friends went from one stopping place to another by train, in advance of the cyclist, to make arrangements for his reception. Practically everywhere along the route this French rider was met by groups of cyclists who escorted him from point to point and showed him the best route to take

FIG. 25

A MODERN LADIES' DROPPED FRAME SAFETY BICYCLE, BUILT BY RUDGE-WHITWORTH, LTD.

to avoid steep hills and thick traffic. In Russia he had rather a sorry time on some of the vilest roads, or apologies for them, that are the only means of transit from town to town when once the rider is away from the precincts of Petrograd.

This cross Continental journey was more in the nature of a record performance than Jefferson's ride to Constantinople, because Terront, on his Rudge, was out to do the distance against time. He set himself the task of accomplishing the total mileage (2,000 miles) in fourteen days, and would have done so but for the bad roads in Russia.

In comparing these rides with any other performance of a similar nature undertaken with the aid of later inventions, such as motor cycles, motor-cars, and aeroplanes, it must be remembered that the cyclists were often alone, that they had in some cases literally to carry their machines over precipitous hills, stony paths, and other almost impassable places. It not only speaks well for their grit and determination that they completed their tasks, but speaks volumes for the bicycles they bestrode that they ever finished the journey as complete units. In fact, the bicycles of the Fraser party, and I think Jefferson's Rover, shed many parts *en route* which had to be replaced when spares were obtainable, or were otherwise patched up to enable the journey to be completed.

CHAPTER XIX

THE MOTOR CYCLE

A book dealing with the cycle industry must necessarily include some reference to the petrol propelled type of cycle which is now so common a feature of our roads. The two industries are also so closely allied that one hardly knows where one begins and the other leaves off.

Practically from the earliest time, when inventors turned their attention to mechanical propulsion on the road, it was the bicycle rather than the carriage on four

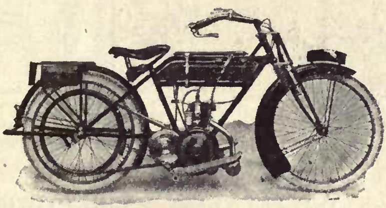

Fig. 26

THE SPARKBROOK TWO-STROKE MOTOR CYCLE, FITTED WITH A VILLIERS ENGINE

The magneto is in the flywheel

wheels that they sought to provide with an engine. Thus it was that the earliest experiment with petrol propelled vehicles was an internal combustion engine fitted to a bicycle by Messrs. Daimler and Otto, in Germany, in 1886. Little was heard of this early trial because the Otto-Daimler engine was afterwards utilized and exploited for use on motor cars. In 1895 a weird motor bicycle appeared in Paris, made by two engineers named Wolfmuller and Geisenhof. This was the first machine offered for public use, and it was brought to Humber's, Coventry, in 1896. It was too crude to gain the attention of the Coventry makers and little more was heard of motor cycles until 1897, when a Paris firm dealing in gramophones introduced the Werner front driven bicycle which, owing to ingenuity and fair reliability for those days, rapidly made a market. The Werner was exploited in this country by a Coventry firm called the Motor Manufacturing Co., who occupied part of the building now used by the Daimler Co.

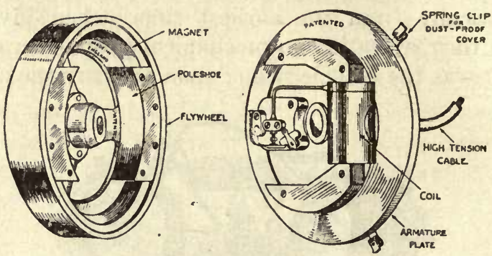

Fig. 27

DETAILS OF THE FLYWHEEL MAGNETO WHICH IS A FEATURE OF THE VILLIERS TWO-STROKE ENGINE

The Werner inspired Coventry cycle mechanics to try their hands at a motor bicycle, but several early models known to the writer never saw more than the four walls of the shop in which they were built, because their tests never got to the road stage.

Two Coventry engineers, named Perks and Birch, were among the first to produce a practical British motor cycle. They were employed by Singer & Co., and their engine was carried inside the wheel of the machine, first in the rear wheel and afterwards, for tricycles, in the front wheel. It was probably the first motor bicycle provided with magneto ignition, but it was of what is termed the low tension type. The modern magneto machine produces a spark in a different manner and it is of a different nature electrically. As this book is not a technical treatise on motor cycle construction, the reader who wishes to know the details of various forms of magneto ignition should obtain Mr. A. P. Young's book, *The Elements of Electro-Technics* (Sir Isaac Pitman & Sons, Ltd.). The Singer bicycle was beautifully made and most ingeniously constructed, but owing to the lack of elasticity in the transmission (it was geared direct to the wheel by toothed gearing) the vibration of the engine was very apparent to the rider.

Between the advent of the Singer and the introduction of the Werner a good deal had been heard over here of another Parisian production, the De Dion Bouton tricycle. These machines had been privately imported by a few enthusiasts in 1898–99, but at the Stanley Show in November, of 1899, the Ariel Cycle Co., of Birmingham, exhibited a motor tricycle and a quadricycle (a tandem passenger machine with four equal sized wheels). Their machine was made under licence from the owners of the De Dion Bouton patents, as were the Eadie and Enfield tricycles and quadricycles which had French made engines and accessories. At the same exhibition a small belt-driven motor bicycle, called the Minerva, and hailing from Antwerp, made its appearance in this country.

The British motor cycle industry can be said to have started with the Stanley Show of 1899, because very little was known about motor cycles in this country until that time. In the following two years or so there was hardly a cycle maker who did not list a motor bicycle with a Minerva engine. Belgian and French makers, however, were not to have everything their own way, for in 1903, a London maker, named J. A. Prestwich, put on the British market a light engine of 28 lbs. which very soon leapt to the front, and was the precursor of the popular J.A.P. engines of to-day. Heavier types of engine were fitted to Excelsiors, and gradually the trade increased. Between 1905 and 1907 the demand for motor cycles showed signs of a slump;

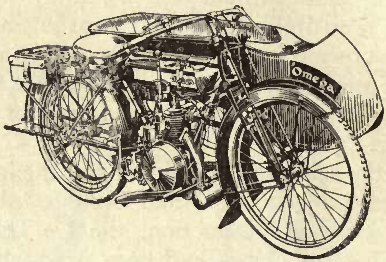

FIG. 28

THE SINGLE CYLINDER OMEGA LIGHTWEIGHT SIDE-CAR MODEL

cycle makers, one after the other, gave up making motor bicycles, but the Bat, Triumph, Quadrant, Rex, J.A.P., and many others, stuck to their guns and despite the vagaries of battery ignition, unsuitable tyres, and other troubles, they were eventually rewarded for their faith in the machine. The arrival of the high tension magneto solved the trouble of accumulator batteries, and firms who were fortunate or sufficiently long sighted to obtain delivery of these machines from Germany, hardly ever looked back. Engines increased in size and power, two and four-cylinder engines were introduced, the latter from Belguim, and very soon practically every youthful and ambitious pedal cyclist was yearning for a motor.

London clubs instituted trials and hill climbing competitions on a big scale, and the advertisement obtained from these largely aided the sale of motor cycles. For a very long time the daily press was extremely cynical respecting motor cycles and, in some cases, they had cause to be. However, Rome was not

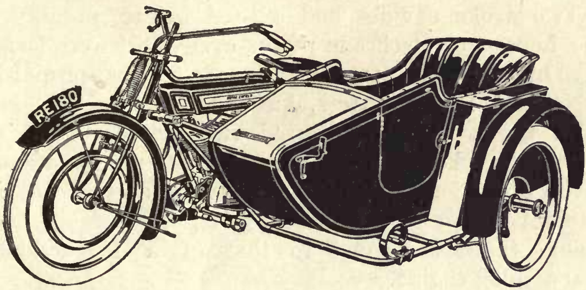

FIG. 29

THE 6-H.P. TWIN CYLINDER ROYAL ENFIELD SIDE-CAR MODEL

The engine has V type cylinders

built in a day, and if some of the incompetent critics on the daily papers had tempered the wind to the shorn lamb a little, the industry would not have been so long climbing the rungs of the ladder of success.

Up to about 1909–10 nearly every motor cycle was fitted with a four-stroke engine, as they are called to differentiate them from the two-stroke type. Briefly, the four-stroke engine has a power impulse, or explosion, every other revolution or every fourth stroke of the piston (down and up being counted as two strokes), whereas the two-stroke has an impulse every revolution or every two strokes of the piston.

In 1909–10, Alfred A. Scott, a Bradford engineer, brought out a two-cylinder, two-stroke bicycle, and it immediately gained prominence. The design of engine and bicycle was clever, and as the modern patterns have won the Tourist Trophy race in the Isle of Man on more than one occasion, it will be recognized that Mr. Scott is more than usually learned in motor cycle construction.

Two-stroke engines had existed before, notably on the Lepape or Bechrone motor cycle, and were largely used in the United States and Canada for boat propulsion in smooth inland waters, but the Scott was different from these. As it possessed two cylinders and the impulse strokes in each occurred alternately at each revolution, the power strokes took place twice during one revolution of the crank shaft, the turning effort being, therefore, equal to that of a four-cylinder, four-stroke engine.

At this period in the history of the motor cycle practically every cycle maker had one or more motor bicycle models to offer, and many who had discontinued their manufacture re-started. In addition, many purely motor cycle concerns were launched to make nothing but petrol cngine propelled machines. The success of the Scott caused a number of makers to turn their attention to the two-stroke engine, which was found to be particularly suitable for small light machines, and the little two-strokes were produced in large quantities at lower prices than had obtained previously. The motor cycle now began to settle down to three classes of machine. 1. A small two-stroke lightweight for solo riding, with an engine of 2 H.P., to sell at about £30 to £40. 2. A medium weight four-stroke, single or twin cylinder machine for serious touring, with an engine up to 3½ H.P., selling at £50 to £60. 3. A heavier single or twin cylinder model from 5 to 8 H.P., for side-car touring, and costing from £75 to £100 complete. (These prices have since been approximately doubled.)

Up to now the motor bicycle only has been dealt with, but quite early in the history of the industry the question of carrying a passenger in a fore-carriage or side-car was seriously attracting the attention of makers and riders alike. The trailer and the quadricycle were the

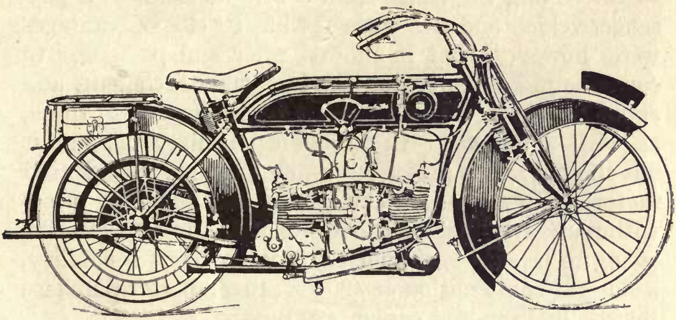

FIG. 30

THE 4-H.P. TWIN-CYLINDER HUMBER

The engine is of the hoiizontally opposed cylinder type

first forms of passenger attachment. They were both superseded, first by the fore-carriage attachment and later by the side-car. Various claims have been made as to the origin of the side-car, but I believe the first practical design was protected by a small London firm of cycle makers and sold to the Cycle Components, Ltd., Birmingham. The idea was ridiculed as unmechanical, but it remains to-day the most economical form of passenger motoring and without it not more than one-quarter to one-third of the motor bicycles manufactured would be sold. The manufacture of side-cars in quantities was first undertaken by Mills & Fulford, Coventry, followed by W. Montgomery, of Bury St. Edmunds. These two firms were for several years the largest makers of this attachment, which was usually bought separately, and was seldom fitted to the motor bicycle until the latter was delivered to the customer. The chief advantage claimed for it, at first, was that it could be attached to and removed from the bicycle, so converting the latter from a solo machine to a passenger vehicle and vice versa at will. Its chief advantages were, however, that it allowed rider and passenger to converse more easily than the fore-car attachment, and above all there were two wheel tracks instead of three, as with a fore-car. Unmechanical it may be, but it fills the bill and is preferred to-day by many experienced motorists to any small car that is obtainable at prices within about 50 per cent. over its cost. In other words, owing to its speed, simplicity, economy, and reliability, a side-car combination at £200 is often a better purchase than a little motor car at £300.

The drawback is that, however well protected the passenger may be, the cyclist has to face bad weather and get wet as in the case of solo riding. The early forms of side-car had wicker and cane chairs, very open and draughty, the passenger sat bolt upright, and there was little comfort in the best of them. To-day a side-car body is made of metal or wood, has a side door, springs in the upholstery, windscreen, hood, etc., just like a miniature car, and the wheel is sometimes sprung on car lines. The passenger is therefore quite as comfortable as if in a motor car and quite as well protected from the wind and rain.

Many firms specialize in the manufacture of side-cars, which are seldom made by cycle or motor cycle companies, and although the frames and wheels are a branch of the cycle industry, it is a trade quite separate from cycle making.

For many years the motor cycle laboured under a disadvantage, in so much that it possessed no change speed gear or clutch. To start the engine the whole machine had to be pushed along at a smart trot until the engine began to work, when the rider had to make a "running mount" and put one foot on the left pedal

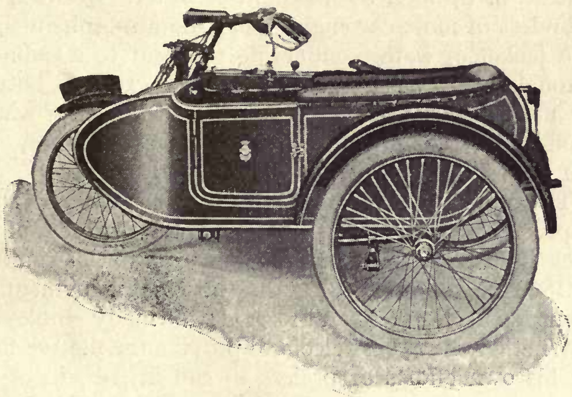

FIG. 31

THE MILLFORD SIDE-CAR

of the crank axle and swing the other leg over the back wheel. This required some agility to perform with success.

Gradually, the trade brought out change speed gears and clutches. The latter enabled the engine to be started with the bicycle at rest, the change speed gear enabled steep hills to be climbed without hard pedalling or dismounting and running alongside. The change speed gears are dealt with separately in Chapter VIII.

The latest models of motor cycle have all the attributes of a well-designed motor car chassis, and some are best described as a car chassis on two wheels. The outstanding difference between a motor car and a motor cycle is that the latter is practically always fitted with an air cooled engine, i.e. an engine which radiates the heat generated by the explosions of gas in the cylinder directly from the cylinder to the atmosphere, instead of through the medium of water. Between the cylinders of most car engines and the atmosphere there is a jacket of water conducting the heat to a radiator, through which the water passes from top to bottom by natural circulation. There are instances of water-cooled bicycle engines and air-cooled car engines, but the cycle engine is normally air-cooled.

The motor bicycle represents the latest and most improved form of cycle extant, and the evolution of the cycle industry from its first introduction to this country, in 1868, to the present day has meant employment for thousands of workers and fortunes for many employers.

Whether the cyclist elects to provide the motive force by his own efforts or prefers to call in the aid of the internal combustion engine is a question of personal choice. The pedal bicycle, as it is termed, provides exercise with recreation, and the motor is therefore scorned by some athletic enthusiasts. The dependability and speed of the motor cycle are, however, now an established fact, and the advantages of the mechanical propulsion cannot be overlooked where time is a factor. On the other hand, the pedal bicycle is a restful and noiseless form of locomotion for those who do not care for the hurry and bustle of a motor cycle ride, and cycling, when undertaken in accordance with ones powers, is probably the most health giving form of recreation for the mind and body.

CHAPTER XX

THE FUTURE OF THE INDUSTRY

To write of the future one becomes a kind of prophet, and the forecasting of events is a dangerous thing to undertake. However, this being the final chapter of my book on the cycle industry, I will risk it on the assumption that if I prophesy what does not materialize, I shall not be alone in having stated what did not subsequently prove true.

The cycle industry of the future is assured, because no matter what happens there always must be a big demand for the cheapest form of locomotion known. Aye, even cheaper than walking. Is not leather more costly than rubber and does not a bicycle tyre cover outlast several boot soles, besides being a quicker means of getting about, either for work or pleasure?

We can therefore safely assume that bicycles will always be with us, because if a very cheap form of power were ultimately devised for propelling a bicycle on present motor cycle lines, no machine so fitted could be produced and sold at the cost of a bicycle that is propelled by human power.

The industry, however, may not remain on its present lines. Like the gun trade and some other industries it may ultimately become so sub-divided that no manufacturer will be able to afford to make a complete bicycle on his own premises. Taking the gun trade as an example, Birmingham is or was, before the war, the centre of the gun making industry. Gun makers date back centuries, whereas cycle makers have hardly attained their fiftieth year. Now the gun trade is so sub-divided that, apart from a few notable examples, a gun assembler can buy every part of a gun from specialists, and the price of the finished article depends on the amount and quality of workmanship that is put into it.

The bicycle trade, with some exceptions, was leaning in the same direction in 1914, and at the time of going to press has hardly recovered from the after effects of the war. It must, however, tend to develop more and more into a specialized form of trade where manufacturers will concentrate on one part, and so reduce prices and competition to such a level that no maker who attempts to make all the machine under one roof can hope to withstand.

At the time these pages went to press there existed a protective tariff on bicycles imported from abroad of $33\frac{1}{3}$ per cent., which held back imports from Germany, U.S.A., and Japan.

Japan has long threatened to export bicycles to this country, Germany could do so with advantage to herself owing to the rate of exchange, and U.S.A. could possibly do a certain amount of trade here. All are at present prevented by a wise tariff from competing with British makers while the latter labour under present difficulties.

No one can tell exactly what will occur, but I think the British cycle maker eventually will be able to survive all forms of competition from abroad, but that will hardly suffice to keep him going on full time if he be barred out of other countries and only has home demands to fill.

The cycle trade has a well organized Union to conduct its annual exhibition, frame regulations for the conduct of its membership in trading with the agents, to watch its interests in Parliament and generally safeguard the industry, the members of which are practically all in the Union.

The full title of this organization is The Cycle and Motor Cycle Manufacturers' and Traders' Union, and its headquarters are The Towers, Coventry; the manager being Major Watling and the secretary Mr. Timerick.

In conclusion, those who imagine the cycle industry has anything left of its old time sporting glamour, when to be connected with it was regarded by some as a pleasant means of existence hovering between work and play, with a big proportion of the latter, should at once disabuse their minds of any such ideas. The cycle industry is now one of Britain's staple trades, and has settled down on industrial lines of great magnitude. Enormous sums of money are locked up in plant and machinery at its various factories and works which produce the subsidiary articles that go to make up that portion of the trade known as accessories. It is quite impossible to give an accurate figure as to the amount of this capital or the number of employees, partly because a good portion of the capital is in private concerns and also on account of the cycle and motor industries being interconnected to so great an extent that it is difficult to say where one begins and the other ends.

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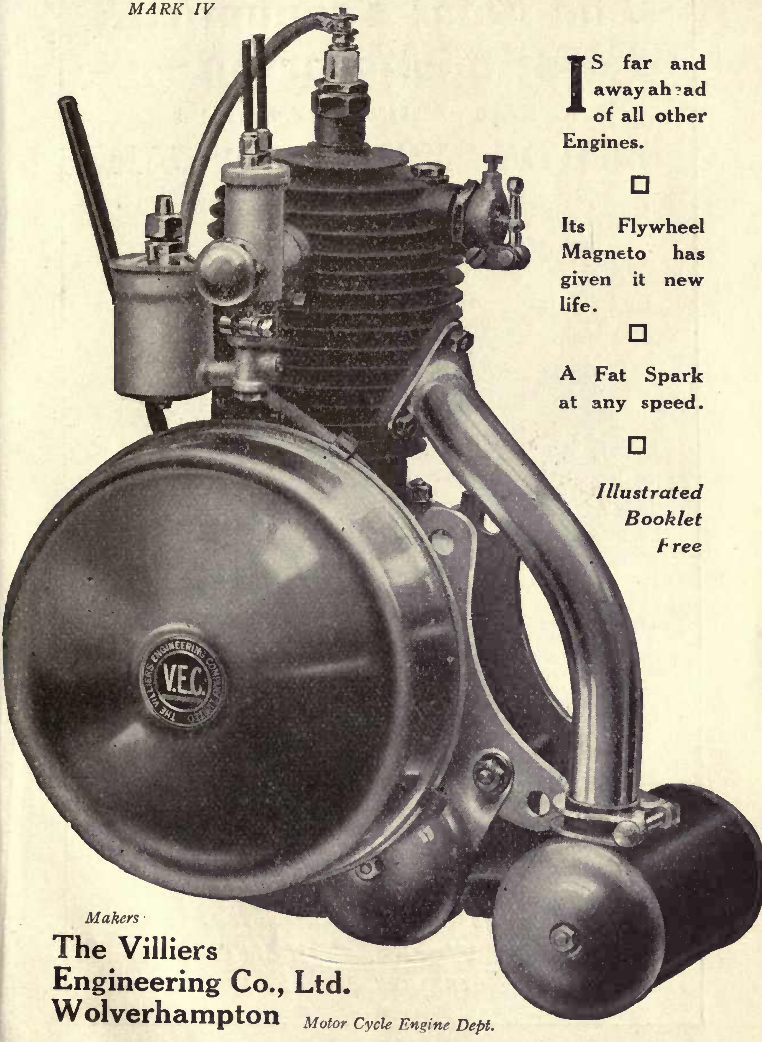

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